DIESEL AND GAS ENGINE PROGRESS

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FIVE DOLLARS PER YEAR

JUNE 1980

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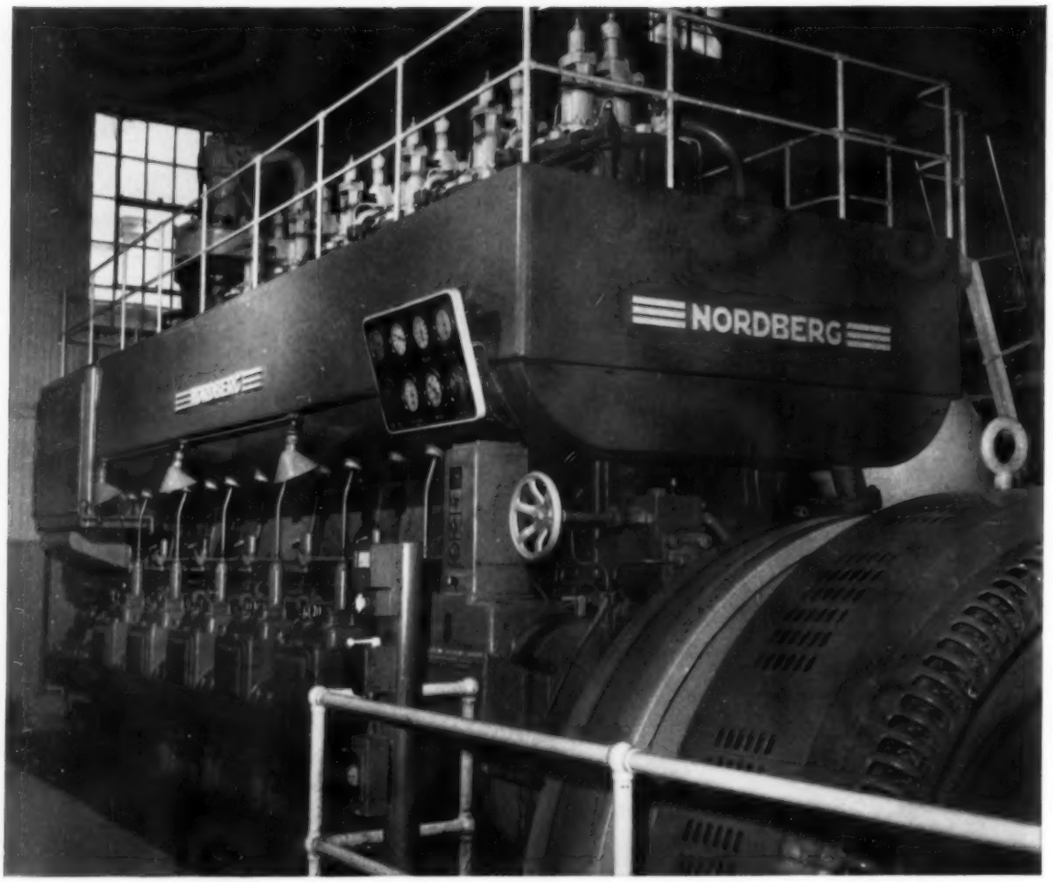

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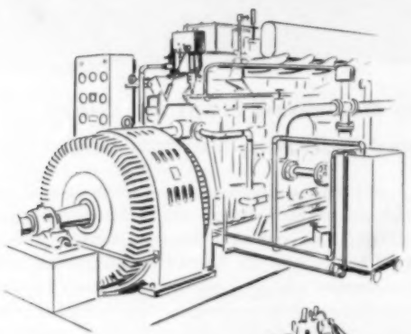
WOODWARD SPEED AND LOAD-SENSING GOVERNORS

LSG-10



Woodward type LSG governors provide the most precise engine speed control ever obtained. Transit time for the smaller one foot-pound LSG-1 governor is approximately 1/100th of a second . . . the larger ten foot-pound LSG-10 approximately 1/40th to 1/50th of a second. This transit time is so fast that the fuel pumps on all but the highest speed two cycle engines are in their new position before the next cylinder is ready to receive its fuel. System speed remains constant regardless of load. Steady state speed control is excellent. While the load-sensing portion of the LSG is electric, the engine is under complete speed governor control at all times. If electrical trouble such as loss of generator excitation, short circuits or damage to the load-sensing circuitry should occur, the speed governor will continue to control the engine with precision and safety. Write for information on Woodward type LSG load-sensing governors for your application.

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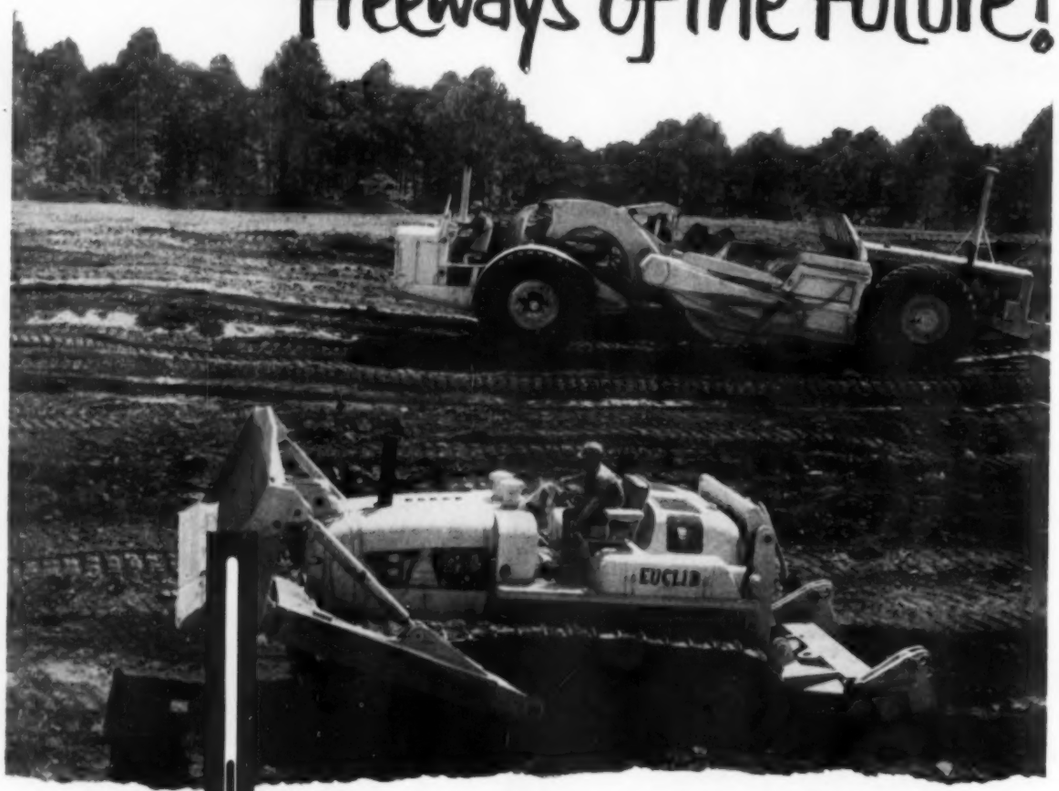

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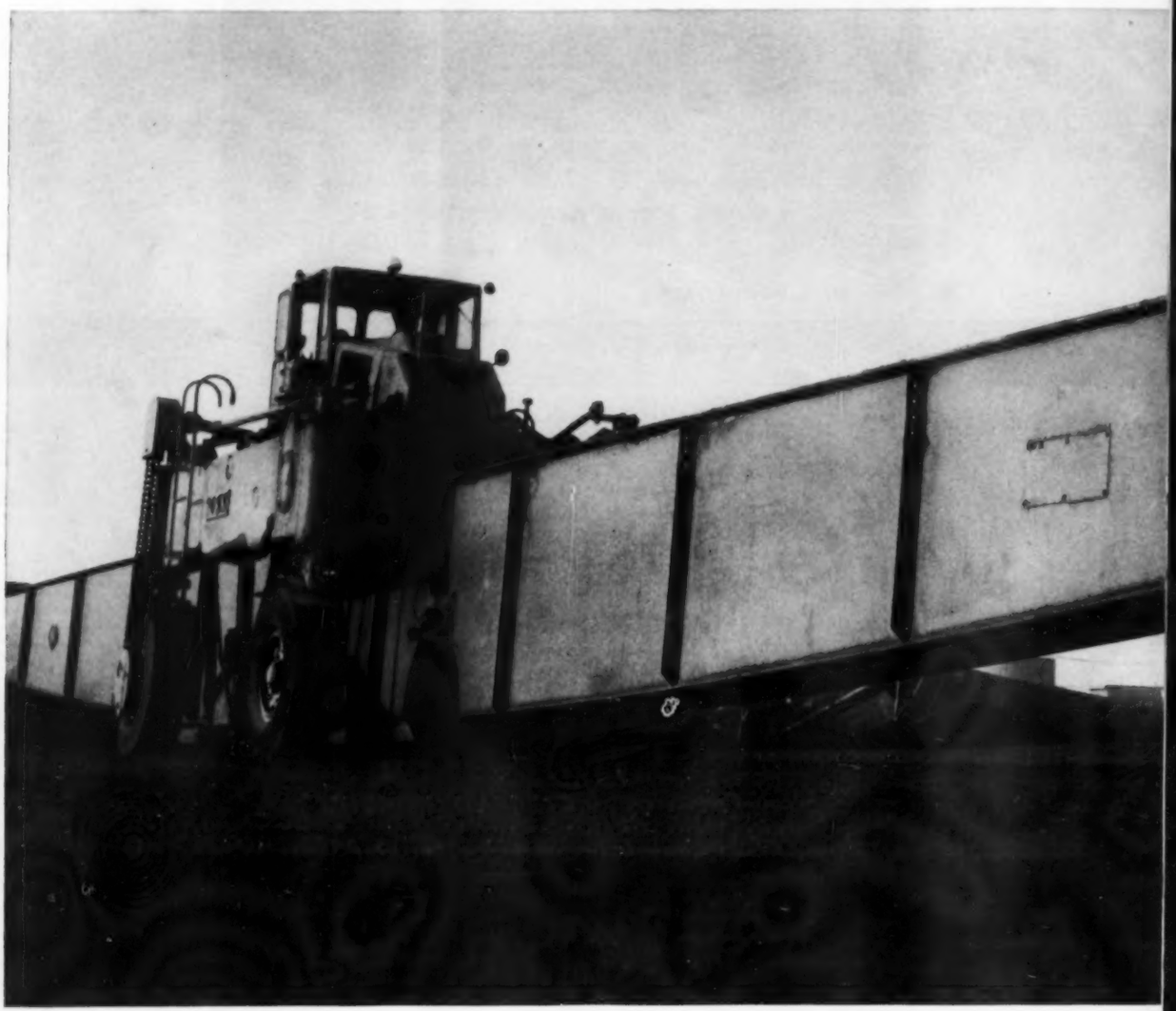
FRONT COVER ILLUSTRATION

International model 95 Payhauler rear dump trucks and a Bucyrus-Erie model 71-B shovel at work on construction of Interstate I-94 in Hamsdon Co., N. J.



"We've installed 25 of the new lightweight, low-

... and maintenance records to date indicate

The Timken Roller Bearing Company is a long-time user of Hercules diesels. In fact, one of the Ross carriers purchased by the firm for a fleet now numbering 20 is powered with a Hercules diesel that has logged more than 17,000 trouble-free hours to date—with only normal preventive maintenance. With this kind of experience, the Timken Company was quick to investigate the new Hercules diesel line when it was released.

Some 25 of the new Hercules engines, ranging from three cylinder sizes to the large, six-cylinder, multi-fuel D-426, are installed in materials handling equipment serving the firm's Steel & Tube Division. Many of these engines have compiled service records of over 2000 hours, with negligible service expense. They give plenty of power for the job, too, even though many of them have replaced heavier, larger displacement diesels.

"If present indications are a guide," says Ed Gumpf, "these new Hercules diesels will be the best investment, in terms of engine-cost-per-hour-of-service, that we've ever made."

The new Hercules diesels, available in a range from 50 to 175 horsepower, are proving more economical to buy and less costly to own for many engine users.

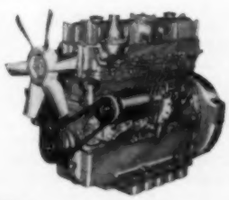
For complete details, call the Hercules distributor near you or return the coupon, at right, to Hercules Motors Corp., Canton 2, Ohio.

cost Hercules Diesels in our equipment

they will save us money"

says Ed Gumpf, Supt. of Materials Handling, Steel & Tube Division, The Timken Roller Bearing Co.

Hercules D-426 Poly-diesel engine can burn diesel fuel, gasoline, kerosene, even JP-4, interchangeably.



HERCULES

WATCH HERCULES FOR THE 'NEW LOOK' IN ENGINES

Hercules Motors Corp.
Canton 2, Ohio

Gentlemen:

Please send me information on your new lightweight, low-cost diesel engines.

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City_____ Zone_____ State_____

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Yesterday at 3:03
MacLeod & Co.

Went out of business

(it could happen to you... TODAY!)

At 3:03 p.m. yesterday this clock stopped.

So did plant elevators . . . one of them mid-floors, with Mac Leod in it. Lights went out . . . computers, tabulators and typewriters "died" . . . critical plant equipment stood useless. Pumps handling continuous-flow processing coughed to a halt . . . and in the laboratories, a crucial experiment requiring weeks of costly preparation was hopelessly sabotaged.

Without the "safety valve" of *adequate* power-generating standby diesel units, thousands of dollars worth of water-cooled processing equipment was quickly "cooked" to scrap iron by the crippling paralysis of power failure.

Seconds before, a catastrophe could have been avoided . . . if a Fairbanks-Morse Opposed-Piston diesel had been on hand, ready to pay for itself within the first few fleeting minutes!

When did you last review your standby power facilities? Yesterday? Eighteen months ago?

When emergency threatens . . . be it electrical storms, high winds, floods, drouth, heavy snows or equipment breakdown . . . you want *adequate* standby power equipment. And you want *the best.*

That, of course, means Fairbanks-Morse, pioneers of diesel building in America. No other manufacturer produces so great a variety of diesel engines for *all* services and purposes, from one-cylinder and five hp to 12-cylinders, 4200 hp . . . and *matching* generators, alternators and generator sets.

Get the facts why F-M two-cycle, Opposed-Piston diesel power . . . turbo-charged or otherwise . . . is unsurpassed for compactness, dependability and fuel savings. Drop a line today to: Fairbanks, Morse & Co., Diesel Division, Beloit, Wisconsin.

Fairbanks, Morse

DIESEL DIVISION

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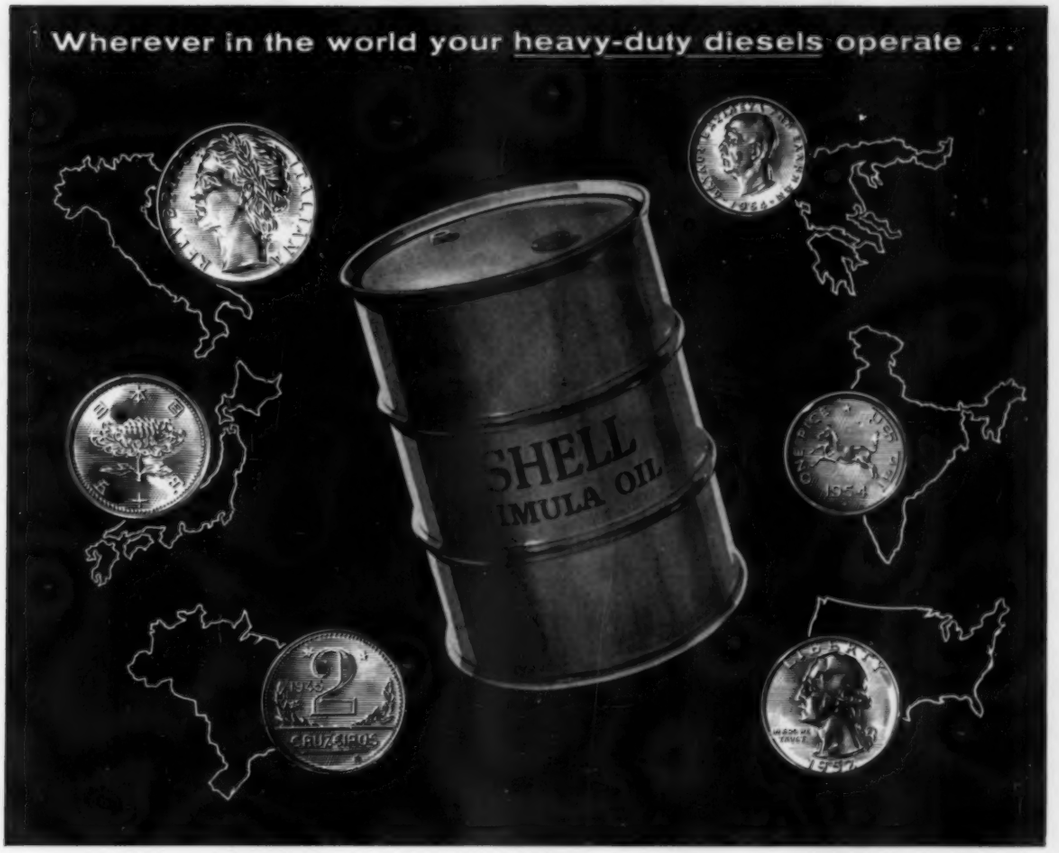

Shell Rimula Oil is there

Other outstanding Shell Industrial Lubricants

Shell Tellus Oils — for hydraulic systems

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AN INTERESTING FACT!
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Around the world, Shell Rimula Oil is available—under the same brand name and providing the same efficient lubrication that your domestic customers rely upon.

Rimula® Oil is a heavy-duty oil that provides the finest crankcase lubrication for today's supercharged diesels. It has proved more than a match for the greatly increased engine ratings, high temperatures and pressures encountered in modern diesel operation. Rimula Oil successfully resists every destructive force that tends to accelerate engine wear.

* * *

The next time your specifications call for a heavy-duty crankcase oil, we suggest you order Shell Rimula Oil. Write or call today for complete information.

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SHELL

GET REAL PRODUCTIVITY-

"On 1200-mile 'weed killer' runs between Seattle and three Idaho cities, Inland's 8V-71-powered Freightliners are saving 14 hours. They make the round trip in 29 to 30 hours—saving 6 hours driving time and eliminating one 8-hour layover for driver rest. On some runs during the busy season, the 8V-71's make three round trips during a week rather than two, earning 50% more for the week than the 6-cylinder units."

"8V-71" FEATURES YOU GET WITH NO OTHER TRUCK DIESEL

- **Gives you 270 to 290 h.p. and weighs practically the same as most 220-h.p. engines.**
- **High horsepower and high torque without turbocharging.**
- **Saves fuel and extends engine life by cruising at an easy-stroking 1700 r.p.m.**
- **This same engine, with a dual-speed governor, also operates at 2100 r.p.m. for faster hill-climbing.**
- **Cuts trip-time on any run as opposed to an ordinary 220-h.p. engine.**
- **More power in less space.**

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GET "8V-71" DIESELS

Makes Two Round Trips Daily Instead of One— because it climbs grades faster in higher gear

You don't have to sell E. W. Sandygren, President of Seattle's Inland Petroleum Transportation Company, on his trucks with "8V-71" Diesel engines —one of the big brothers in the "71" Series family.

"Our truck No. 33 makes *two* 416-mile round trips daily between Pasco, Washington, and Grangeville, Idaho," he reports. "Our other trucks with 6-cylinder engines take 13½ to 14 hours to do it *once*. And since both of them keep to the 45 m.p.h. speed limit, No. 33 *has to* be making up the time on the grades."

Actually, this is a pretty typical report for trucks powered with "8V-71's." Truckers the country over are discovering that here, at last, is a real truck engine that can give them 270 to 290 hill-climbing horsepower—with practically the same weight as most 220-h.p. Diesels. "8V-71's" develop their high power and torque *without* turbochargers of any type.

Even when equipped with smaller fuel injectors for increased economy, they still develop more power at lower r.p.m. than the usual 220-h.p. engine. This means less maintenance, longer engine life!

Or you can have an "8V-71" with a dual-speed governor and team it with a fast-ratio axle. That *really* lets you have your cake and eat it—with engine-saving, fuel-saving r.p.m. for normal going AND plenty of reserve power at 2100 r.p.m. to make better time on every hill.

Here, then, is a Diesel engine that's bound to save you time and money in the toughest operations. Proof? See your GM Diesel Distributor—he's in the Yellow Pages under "Engines, Diesel." And for a comparison of Diesel vs. gasoline costs, write for the GM Diesel Operating Savings Computer. Get one—free—by mailing the postcard today!

DETROIT DIESEL ENGINE DIVISION
GENERAL MOTORS, DETROIT 28, MICHIGAN
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Parts and Service Worldwide

LINE SETS THE STANDARD OF DIESEL PRODUCTIVITY

new LONG LIFE PISTON

Puts CAST IRON WEAR IN TOP RING GROOVE

G and E Wire Insert Piston before machining (left) and after ring grooves are cut (right) showing how the steel wire forms a tough wear-resistant surface on both faces of top ring groove. The ferrous plug molded in the head (for diesel pistons) prevents burning through head and lengthens diesel piston life!

G and E WIRE INSERT PISTONS

★ **Low initial cost— Low cost per mile**

★ **Amazing increase in piston life**

★ **Maintains new engine power and performance**

Here's an entirely new piston design that combines all the advantages of aluminum alloy pistons with the long life of steel in the top ring groove. No noticeable increase in weight. G and E Wire Insert Pistons are real top performers at LOW COST—barely more than ordinary alloy pistons!

This Gillett & Eaton exclusive steel wire insert cuts top ring groove wear and greatly increases mileage between overhauls.

You get longer piston wear at lower cost because G & E Wire Insert Pistons have a pre-shaped steel wire cast right in the piston wall where the top ring is located. When the grooves are machined, this tough wire is cut, exposing the closely spaced hard surfaced bearing points on top and bottom faces of the groove.

CAST IRON

ALUMINUM

GET THE G AND E WIRE INSERT STORY—it will save piston money, maintenance costs, and cut operating costs.

GILLETT AND EATON, INC. 855 DOUGHTY STREET • LAKE CITY, MINN.

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The Torque Converter is Twin Disc
Since 1937, Twin Disc Clutch Company has specialized in the manufacture of torque converters for powered industrial equipment. Crawler tractors represent one of the most successful applications. In fact, all three of America's leading tractor builders offer Twin Disc Torque Converter Drive as standard or special equipment. Twin Disc Converters promote faster cycles and higher output day after day.

TORQUE CONVERTER DRIVE

delivers extra power when it's needed most in International's turbocharged TD-25

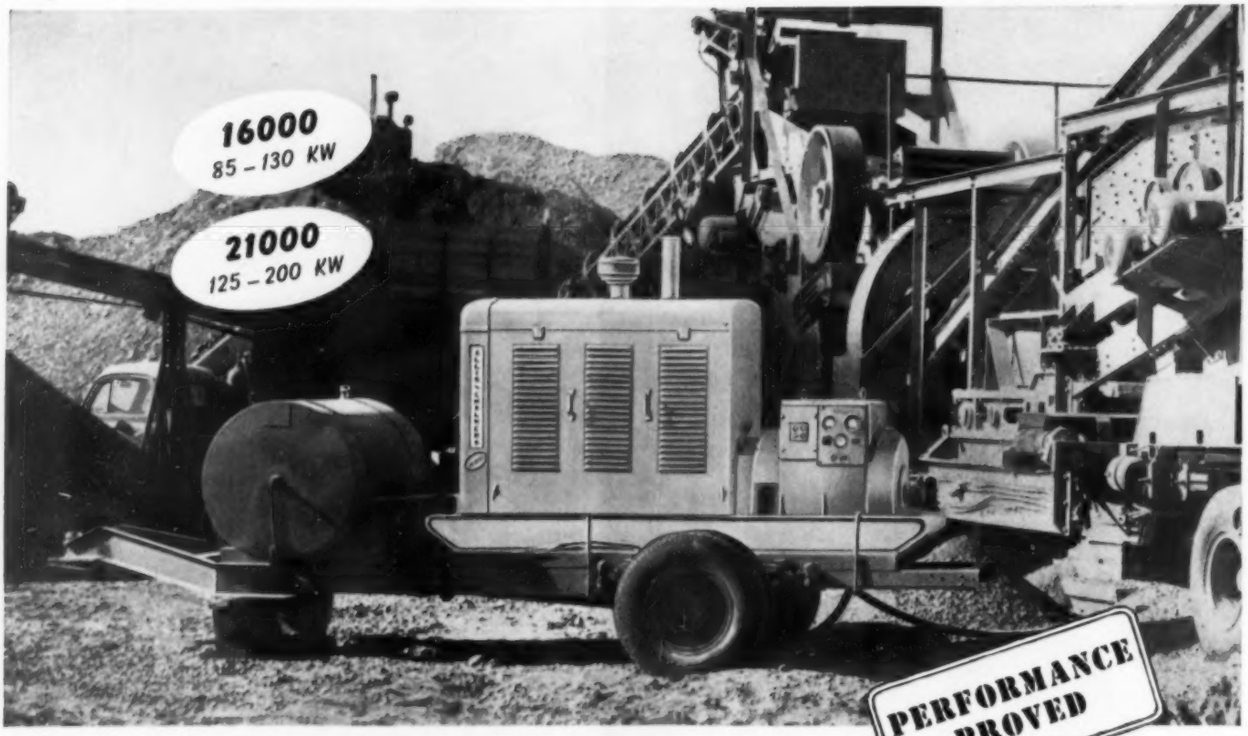
The new TD-25 is a king-sized 230 hp machine developed by International to handle the toughest earth-moving, pipelaying and logging assignments.

One of the biggest production-boosting features available on the TD-25 is torque converter drive. It eliminates lugging and stalling . . . lets the powerful turbocharged engine work in its maximum efficiency range *all* the time to deliver *constant* high-horsepower output. Drawbar pull and traveling speed are automatically matched to load demands within each of four gear ranges.

You'll get peak production and profit on every job with the torque converter equipped TD-25. See your International Construction Equipment Distributor for a demonstration soon.

TWIN DISC
Torque Converters

TWIN DISC CLUTCH COMPANY, Racine, Wisconsin • Hydraulic Division: Rockford, Illinois



This Allis-Chalmers 16000 diesel generating set provides electric power for motors on a crusher operating near Great Falls, Montana. Primary power source for the crusher is an Allis-Chalmers 21000 turbocharged diesel power unit, companion to the 16000.

NEW A-C DIESEL GENERATOR SETS
WITH BRUSHLESS GENERATORS
show outstanding performance advantages

Can save $3,000 a year on fuel alone — Users tell us the 21000 turbocharged diesel saves as much as 2½ gal. of fuel in every 10 compared with other engines, or 1 to 4 gallons for every hour of operation.

"Startingest engine we ever had," says a northern user. "We threw away the ether can with temperatures way down below freezing — no external heating either." With their unique controlled combustion, these engines start and pick up loads in 4 to 10 seconds.

Safe in dusty, corrosive or explosive atmospheres — Brushless generators have new simplicity. There are no slip rings, no brushes, no commutators to wear or to spark. They are replaced by newly developed, non-aging silicon rectifiers that rotate with the armature.

Precisely regulated power — New Allis-Chalmers magnetic amplifier type static voltage regulator has no moving parts or contacts, no parts to burn or wear. There's unequaled fast response to sudden changes in load — heavy motor starting loads are easily picked up.

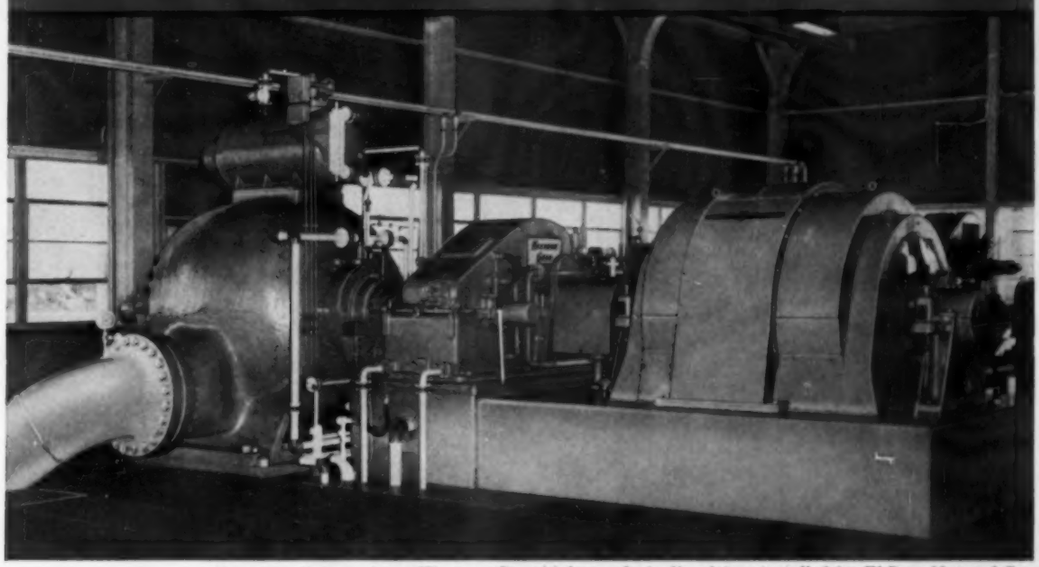
Allis-Chalmers manufactures and stands behind all four major components. This means coordinated engineering, matched performance, undivided responsibility — an Allis-Chalmers exclusive. Sets are simple, unit-type, self-contained — mounted on husky skids. No special foundation required, no danger of misalignment. Electrical connections are simplified to speed installation and reduce related costs. See your dealer for more about these outstanding 16000 and 21000 sets. Allis-Chalmers, Milwaukee 1, Wisconsin.

BG-40

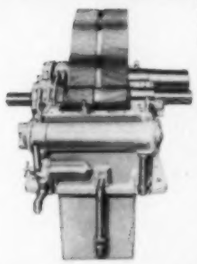
ALLIS-CHALMERS
***POWER* FOR A GROWING WORLD**

WESTERN GEAR

pipeline drives on stream at EL PASO NATURAL'S LEUPP STATION



Foreground: one of two Western Gear high speed pipeline drives installed for El Paso Natural Gas Company in its Leupp Station, Leupp, Arizona. Both drives are catalog model 300 HS 150 units, rated at 5750 h.p., with input of 1200 r.p.m. and output, 8494 r.p.m.



on the long run...

QUALITY COSTS YOU LESS!

Where there is obviously no compromise with quality, you'll find Western Gear. El Paso Natural Gas Company's Leupp Station, using the Ingersoll-Rand compressor powered by a General Electric Motor, is an example of reliance on Western Gear where performance and dependability are vital.

Pipeline companies throughout the world rely on Western Gear hi-speed gear units. Western Gear single stage pipeline drives are in use by Texas Eastern, Transmountain, Warren Petroleum, Union Oil, Trans-Arabian, Petroleos Mexicanos, Spanish Pipeline, Richfield Oil, Great Lakes and Mid Valley. Transwestern and Columbia-Gulf, using engine driven centrifugals are equipped with two stage high speed units, an application pioneered by Western Gear.

But pipeline experience is not the whole story. At Western Gear, many products are built requiring extremely close tolerances and rigid quality controls, including Magnafluxing and X-Ray and ultrasonic inspection. These range from 45,000 h.p. marine drives to highly loaded, lightweight gears, and super-precision drives for speeds to 100,000 r.p.m. and gear pitch line velocities approaching the speed of sound.

In such an environment, design and production of high speed pipeline drives falls easily within the scope of Western Gear's everyday experience.

For full information on Western Gear pipeline drives, write, wire or phone: WESTERN GEAR CORPORATION, Industrial Products Division, P.O. Box 126, Belmont, California, Phone LYtel 3-7611.

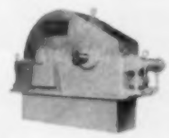
WG INDUSTRIAL PRODUCTS DIVISION

OTHER WESTERN GEAR POWER TRANSMISSION CATALOG PRODUCTS

INTEGRAL GEARMOTOR

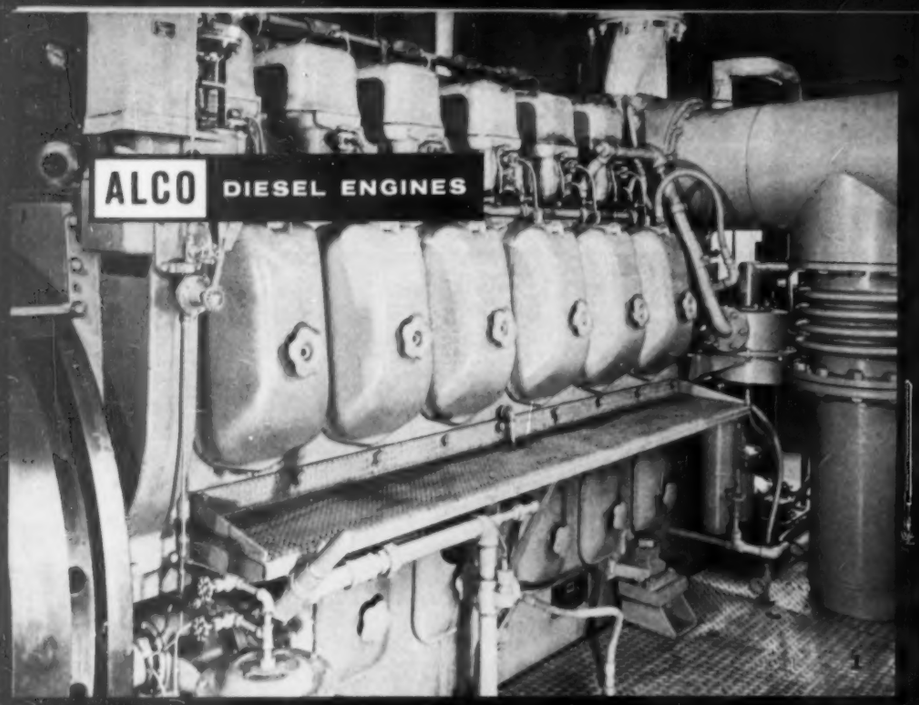
PARALLEL SHAFT REDUCER

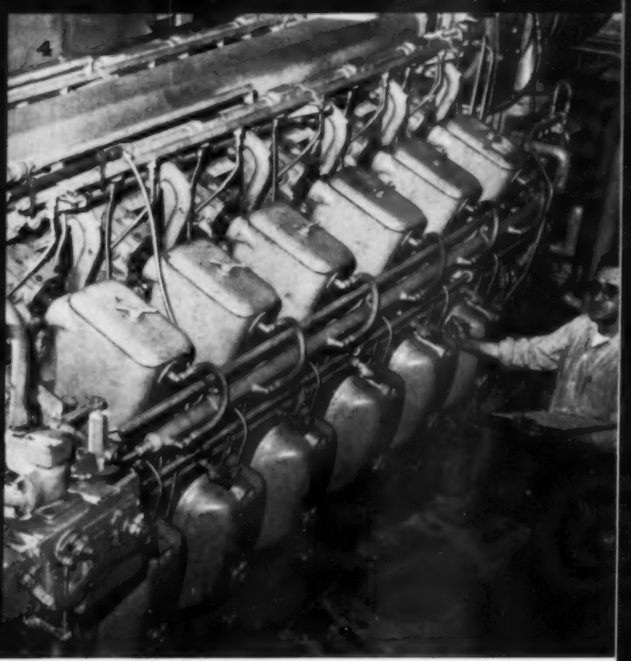
VERTICAL SHAFT REDUCER



HIGH SPEED UNIT

RIGHT ANGLE REDUCER





THE NEW BIG MUSCLE IN DIESELS

Around the world—in all kinds of tough diesel-power jobs—ALCO's 251 diesel engine has proved that it delivers the versatility, economy and stamina needed for profitable operations. Here are a few examples:

1. Microwave signals from 100 miles away direct an ALCO six-cyl 251, pumping liquid petroleum products on a Kansas pipeline. After two years of remote operation—8000 total hours—an inspection revealed the engine could run at least twice as long without overhaul.

2. Three 251's power a large offshore drilling platform. The operator reports that fuel consumption is much lower than competitive engines, while the 251's controllability allows him to speed up costly drilling operations.

3. Tugboats like the *Savannah* use 16-cyl 251's to get power for heavy tows on high seas. Operators report low maintenance, with three to four years' operation before overhaul. The 251's fuel consumption—15 per cent less than competition—permits longer tows.

4. A steel company uses an ALCO 251 as standby, pumping cooling water to open hearths. Recently, during a power stoppage, the 251 assumed the whole pumping load, saving thousands of dollars of furnace damage.

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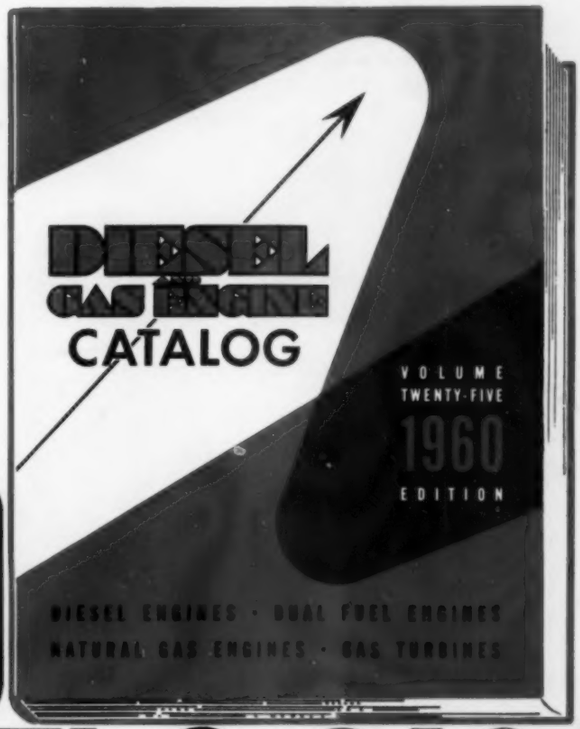

LOOK AT THE CONTENTS!

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2. TURBOCHARGERS and SUPERCHARGERS — This section of manufacturers is detailed and fully illustrated to give complete information on this increasingly important phase of the industry.

3. TRANSMISSIONS — The latest information on torque converters, fluid drives, and other modern means of transmitting power are fully described and illustrated in this section.

4. ACCESSORY EQUIPMENT — Recent developments in fuel injection systems, governors, and other key accessory units are detailed and illustrated fully in this section.

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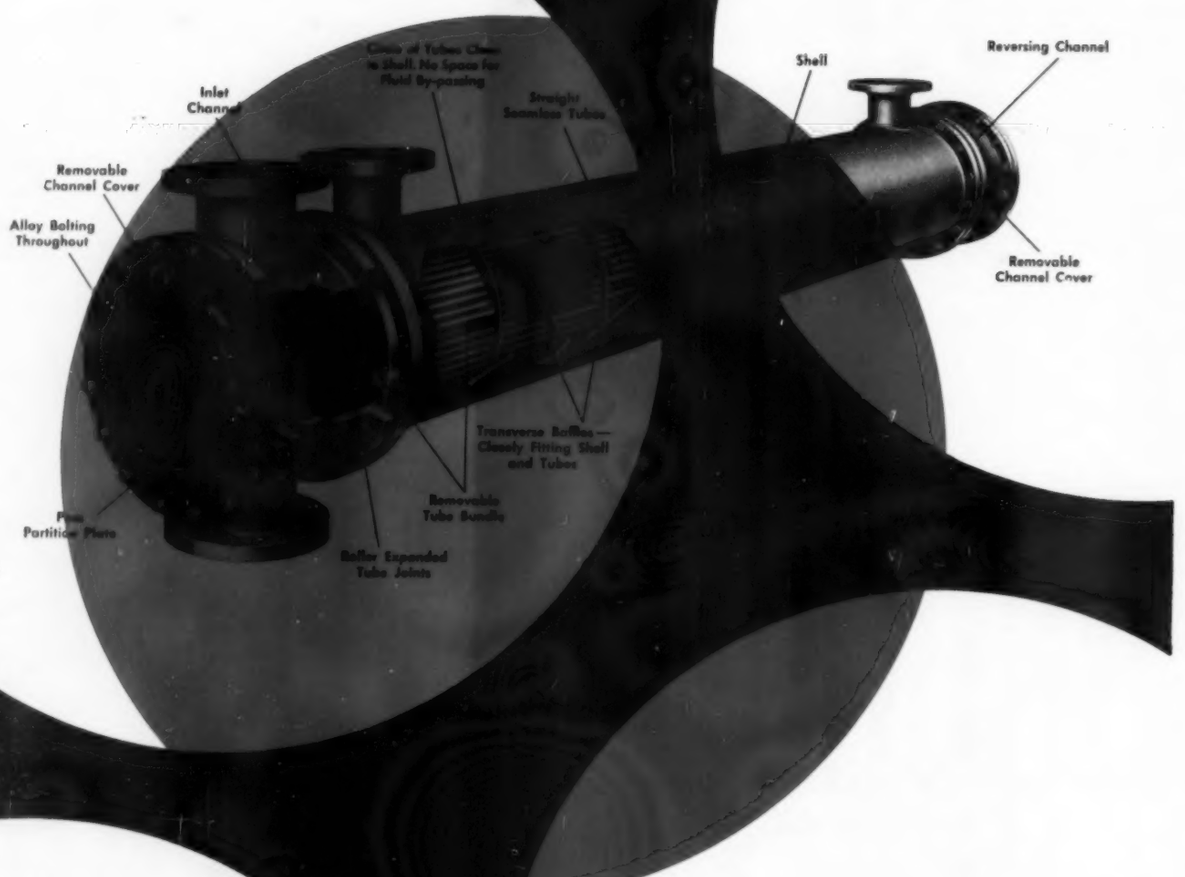

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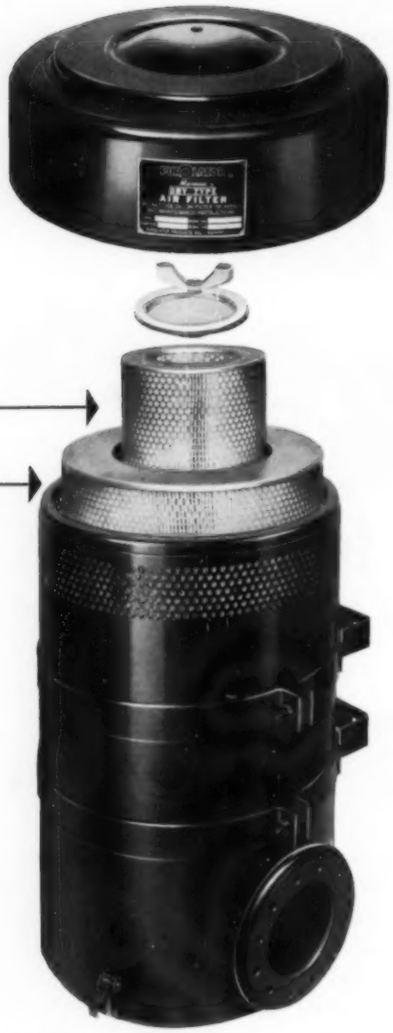

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and an element here

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Boosting this small block engine to 71 horsepower and greatly increasing its versatility, the above pictured T-6 model also provides up to 10 percent better fuel economy.

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DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND SPECIALIZED INDUSTRIAL PRODUCTS

ROLL ON-ROLL OFF TRAILERSHIP M/V *COHO*

New Vessel Will Ferry Vehicles, Passengers Between Port Angeles, Wash., and Victoria, B.C. Power Is Supplied by Pair of Cooper-Bessemer 2080 SHP Turbocharged Engines

NEW combination roll on-roll off trailership and auto passenger ferry, the *M/V Coho* is the first completely new, privately financed vessel of its type built in this country. The vessel, which entered service late in '59, operates between Port Angeles, Wash. and Victoria, B.C. Powered by two Cooper-Bessemer marine diesels each rated 2080 shp and operating on residual fuel, the 341 ft. *Coho* has a service speed of 16 knots, with a 5315 gross tonnage.

Fully meeting requirements of the U.S. Bureau of Shipping, the *Coho* was designed by Philip F. Spaulding & Assoc., Seattle naval architects, and built by the Puget Sound Bridge and Dry Dock Co., also of Seattle. The new vessel is owned and operated by Black Ball Transport, Inc., Seattle trucking firm. The *Coho* will replace the *Iroquois*, an older ship which in recent years was engaged exclusively in roll on-roll off trailership trade. In addition she will replace the summertime runs of

Top—The mighty *M/V Coho*, powered by two Cooper-Bessemer diesels, is impressive in her sea trials. Lower—Black Ball trailer is loaded through the stern door prior to leaving the Seattle port.

three auto-passenger ferries operating between Port Angeles and Victoria, B.C. All these tasks can be performed by the *Coho* because she was designed and built specifically for this trade and given enough power to handle more cargo faster.

The *Coho* can carry 76 trailers, each 20 ft. long, or 100 automobiles. In addition, she has accommodations for 500 passengers in the summertime runs and 280 during the winter. She has a waterline length of 320 ft.; length between perpendiculars is 308 ft. Molded width at the design waterline is 55 ft. 6 in. while extreme width over the guards is 73 ft. 1½ in. Design load draft is 12 ft. 6 in. The ship is manned by six officers and 20 crewmen, a complement only slightly larger than the trailership replaced by the *Coho* even though the latter has 150 percent more cargo capacity.

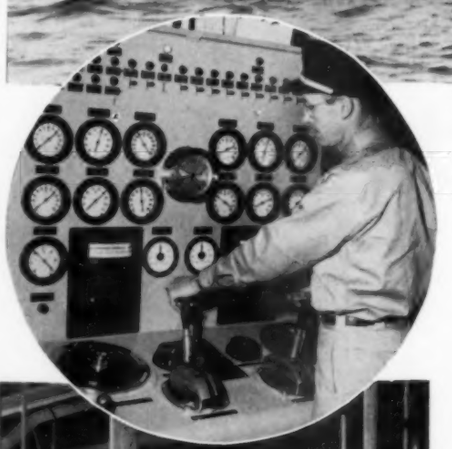
Propulsion power on the *Coho* is provided by a pair of Cooper-Bessemer LS8 DRT diesel engines. These direct reversing, matched right and left hand, turbocharged units with eight cylinders and bore and stroke of 15½x22 in. are each rated 2080 hp at 330 rpm. Each engine drives a 96 in. propeller, being direct connected through 7¼ in. propeller line shafts and 9⅛ in. tailshafts. Main engine controls are Westinghouse Air Brake single lever type arranged on a console located in the main engine room. The engines drive the jacket water pumps and lube oil pumps and are equipped for air starting. They burn either No. 5 residual boiler fuel or regular diesel oil. The vessel has a storage capacity of 1,686 bbls. of heavy fuel, 277 bbls. diesel fuel, and 73 bbls. of lube oil.

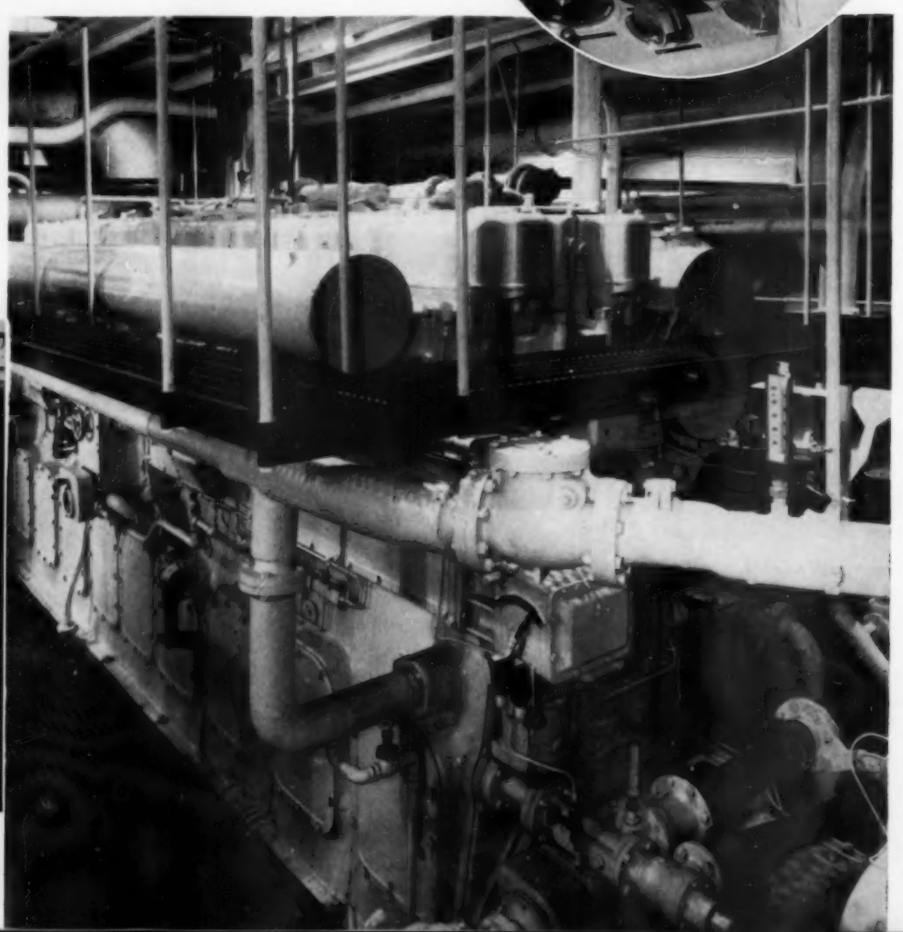
Electricity for ship's service is supplied by two Cummins VT-12 diesel engines driving Marathon 250 kw 450 volt, 3 phase, 60 cycle ac generators. The engines, turbocharged, 12 cylinder models with bore and stroke of 5⅛ x 6 in., are rated 390 hp at 1800 rpm.

For emergency service, a Cummins NH-6 diesel engine driving a Marathon 100 kw, 60 cycle, ac generator is mounted in the ship's funnel. This engine has six cylinders, and bore and stroke of 4⅞ x 6 in. Naturally aspirated, it is rated 143 hp at the 1800 rpm at which it drives the generator.

The *Coho* has enough clearance and structural strength to handle any vehicle lawfully permitted on Washington highways. Side port and stern loading capabilities were designed to suit existing loading ramp facilities and the stern door and side port openings were made wide enough to handle two lanes of traffic. Due to the overall tidal range of 16 ft., particular attention was given to provide proper door heights so that legal over-the-road trailer vans could be handled at any stage of the tide. Main deck obstructions were reduced to absolute minimums to permit easy maneuvering of trailers to speed storage.

Because of the heavy boat and ship traffic and small, restricted harbor at Victoria, the *Coho's* full load draft was limited to 12 ft. 6 in. The vessel also was provided with twin rudders of large size to give her high maneuverability going dead slow ahead or astern and while maneuvering in high cross winds. The steering engine is an electro-hydraulic gear and is controlled by a hydraulic telemotor system. The twin rudders are connected to the rapson slide ram assembly yoke by two forged





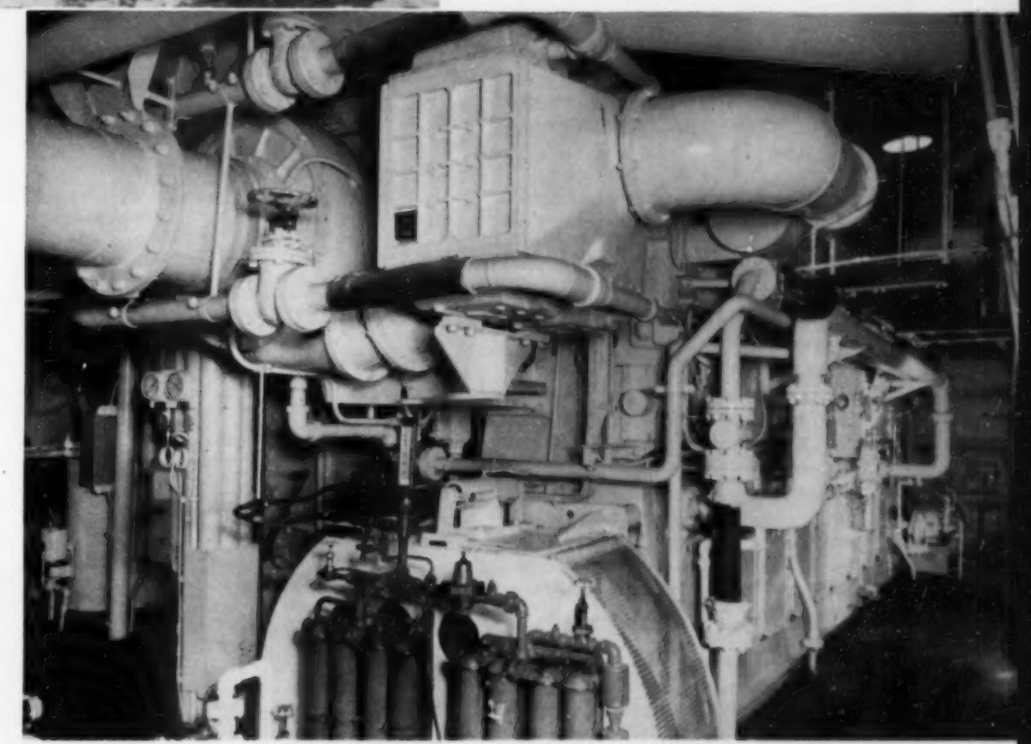
After end of one of two Cooper-Bessemer LS8 DRT diesel engines. Engines are equipped with Woodward governors, Viking lube oil pump, and Ross lube oil coolers. This eight-cylinder engine is rated 2080 shp at 330 rpm.

Rolls of newsprint join other cargo aboard the *Coho*. Hold has three lanes for trailers on each side of centerline and can carry 76 trailers or 100 automobiles

M/V Coho heading out of Seattle on her first run. The roll-on roll-off trailer ship is 341.5 ft. long; service speed is 16 knots.

Chief engineer of the *Coho*, Harold Graham at the main engine control console. Board is equipped with Westinghouse Air Brake single lever type control and note Alnor exhaust pyrometer.

Forward end of the *Coho's* starboard engine. Note Young intercooler, CFC Fulflo fuel oil filters. DeLaval heavy fuel oil centrifuges are used.



steel links which in turn are connected to the rudder tiller arms. The hydraulic pumps are driven by electric motors.

Large ballast tanks were provided fore and aft to take care of trim during a partial load and while making landings at high tide with the ship in light load condition. The four ballast tanks are connected by six inch ballast mains and have capacity totaling 1026 tons of water.

The hull of the ship is transversely framed with the main and promenade decks continuous for the full length of the hull. A full double bottom is fitted from the forward ballast tanks and the main engine room foundation forms an integral part of the double bottom structure. The vessel is subdivided by nine transverse watertight bulkheads carried tight up to the main deck to give her a full two-compartment subdivision standard.

A system of three longitudinal deck girders and stanchions per side are fitted to reduce the effective length of deck beams and provide for heavy wheel loadings resulting from carrying trailers and trailer vans. The hull is sponsoned out to provide three lanes for trucks and trailer vans and four lanes of autos on each side of the centerline machinery casing. A full 14 ft. 4 in. of headroom is provided throughout the vehicle space on the main deck. This increases to 15 ft. at the stern doors and the side ports forward.

Because the vessel will cross the Straits of Juan de Fuca, life saving equipment has been provided in excess of ferry boat requirements and complies fully for vessels operating on lakes, bays and sounds and navigating waters tributary to the Pacific Coast of the Continental United States. Crossing the Straits affords one of the most spectacular scenic trips in North America and special consideration for this was given in the design of the *Coho*, especially in the area of large observation windows. Seating for 138 passengers is provided in the observation lounge forward of the observation deck. In the sitting room amidships on the promenade deck there are accommodations for 168 passengers and an additional 72 in the coffee shop.

Officers are berthed in single staterooms on the navigating bridge deck. Each officer's stateroom is fitted with a single 36 in. wide built-in berth, desk, chair and wardrobe locker. The crew are all berthed on the sun deck in double staterooms. The ship's galley is located aft of the crew's quarters in the sun deckhouse between the crew's messroom and the officer's messroom. An owner's suite consisting of lounge, owner's cabin and guest cabin is located on the after portion of the sun deckhouse for use by special customers, shippers and dignitaries.

Principal Equipment Serving *M/V Coho*

Main engines (2)	Cooper-Bessemer
Main engine controls	Westinghouse Air Brake
Governors	Woodward
Engine after-coolers	Young
Starting air compressors	Quincy
Fuel and lube oil filters	CFC Fulflo
Fuel oil heaters	American-Standard
Lube oil coolers	Ross
Fuel oil centrifuges	DeLaval Separator
Thermostatic controls	Amot
Air intake silencers	Maxim
Exhaust mufflers	Burgess-Manning
Exhaust pyrometers	Alnor
Jacket water coolers	Ross
Auxiliary diesels (3)	Cummins
Auxiliary generators	Marathon
Fuel and lube oil	Shell

INLAND PETROLEUM'S V-8'S SPEED NORTHWEST RUN

290 HP 8V-71's Installed in Kenworth and Freightliners Cut Trip Time on Mountainous Routes for Trucker Specializing in Hauling Petroleum Products and Liquid Chemicals

By DWIGHT P. ROBISON

WHEN the Detroit Diesel Engine Division of General Motors introduced its All-Purpose Power Line in January 1959 it was predicted that at least four of the Division's new models would prove especially important to the trucking industry.

The engines referred to are a four cylinder in-line engine of 130 bhp and a six-cylinder V unit of 185 bhp in the new 53 series; also six- and eight-cylinder V engines of 218 and 290 bhp respectively in the well known 71 series.

Although these engines have been put to work throughout the country, Inland Petroleum Transportation Co. of Seattle, Wash. was one of the first major fleet owners to report on the 8V-71. This engine develops 290 hp at 2100 rpm without turbocharging. Despite the fact that it is shorter than the Division's in-line 6-71, it offers the trucker more than 70 additional horsepower with which to negotiate steep grades and also to take care of gvw increases which may become allowable in the future. The reserve power available from the engine allows truckers to use faster axle ratios and a dual-range governor set-up. This limits operation in the higher gears to 1800 rpm for maximum fuel economy and longer engine life, while still allowing the engine to peak at 2100 rpm in the lower gears for increased performance and faster hill climbing.

Inland Petroleum, headed by E. W. Sandygren, president, began operations in 1935 and currently has 50 diesel trucks and diesel tractor-trailer combinations in service. It provides well organized, efficient transportation for a wide variety of products in Washington, Oregon, Idaho and the Canadian province of British Columbia. Despite its name, cargos are not limited to petroleum products alone, as the company also handles at least 15 different kinds of chemicals and a number of food products. Round trips for the IPT vehicles vary from 300 to 1100 miles and because of the cargos handled, the company must adhere closely to rigidly controlled timetables.

Newest of IPT's over-the-road tractors are one CC 925 Kenworth and three 8245L White COE Freightliners, all four of them powered by 290 hp, 2100 rpm 8V-71's. These diesels drive through Spicer clutches and transmissions to Timken tandem rear axles with a gear ratio of 4.57:1. Although they are not currently using a dual-range governor set-up, fuel consumption of the 8V-71's has been approximately equal to the conventional engines of lower horsepower operating in the company's fleet.

Mr. Sandygren says, "There's merit in Detroit Diesel's contention that the 8V-71 is a high production power unit. In our four new tractors, it has amply proven its ability to get more work done or to get the same job done in less time. Our Kenworth truck Number 33 with an 8V-71 is able to make the

E. W. Sandygren, President of Inland Petroleum Transportation Co.

Inland Petroleum Transportation Company's truck No. 33 taking a grade with a full load at about 45 mph on the new highway between Seattle and Mount Vernon, Wash. The 76,000 lb. GCW includes a payload of fuel oil from an Anacontes, Wash. refinery. "No. 33" is a Kenworth 3 axle, 10 wheel truck and trailer rig powered by an 8V-71.

Truck Number 68 operated by Inland Petroleum Transportation Company is this Freightliner cab-over Tractor shown hauling a 76,000 GCW load of caustic soda in the foothills of the Cascade Mountain range in Washington. "Number 68" is one of three Freightliners owned by the company all of which have the 8V-71 diesel with Spicer clutch and transmission.

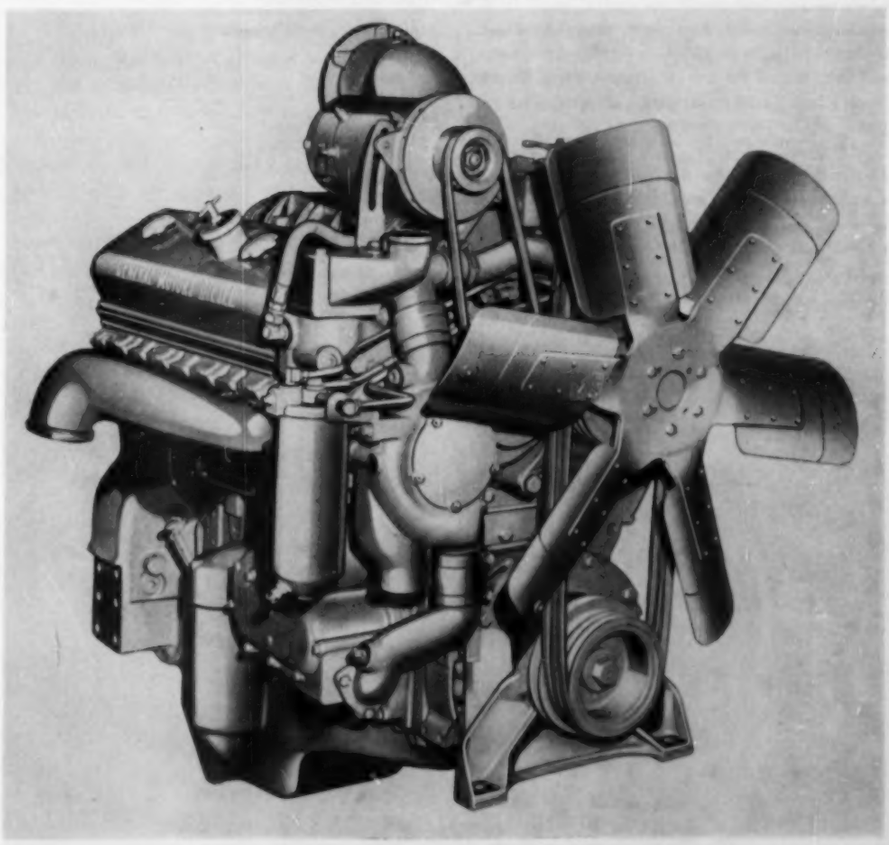
"On more typical runs," said Sandygren, "the engine itself is responsible for any gains shown. Here our 8V-71-powered trucks will cut two full hours off a 15¼-hour round trip. Where our other trucks take 15¼ hours for the trip, trucks powered by the 8V-71 make the same trip in 13¼ hours. This amounts to over 13 per cent faster time being made by the 8V-71 trucks. And again it should be emphasized that since all our trucks have the same 45 mph speed limit, the 8V-71's make better time on the grades."

Having a reserve of power to maintain speed on the grades obviously means less gear-shifting as well. Mr. Sandygren said: "As a matter of fact we can count on at least one-half gear better with the 8V-71's on any grade. This means more speed on grades and consequently higher average overall speed. We are really pleased with the 8V-71." Sandygren continued: "We had over 100,000 miles of trouble-free operation on our first unit and the life of these engines should hit the million-mile mark easily. Our drivers like it, too. The 8V-71 has the reserve power to take care of future load weight increases which may be allowed, so it is not only the trucker's engine for today but also for tomorrow."

Pasco to Grangeville, Idaho round trip—a distance of 416 miles—twice within a 24-hour period. Other trucks in our fleet require from 13½ to 14 hours to make a single round trip on the same run. Since the same 45-mile-per-hour maximum speed limit applies to all of our trucks on this run, it is obvious that the 8V-71 powered truck makes better time on the grades."

Another situation in which the better-sustained speed of Inland's 8V-71-powered trucks is paying off came about as a result of I.C.C. regulations. This is on what company drivers call the "Weed Killer" run from Seattle, Washington to Twin Falls, Boise, and Idaho Falls, Idaho and return. The round trip distance on this route is about 1200 miles, so it is a "roll-and-rest" run. Inland trucks have required about 36 hrs. of actual driving to make the round trip. After each 10 hours of driving, however, the drivers are required to rest eight hours—at 10 hour, 20 hour and 30 hour intervals. On the 1200 mile round trip, the company's trucks had therefore been requiring 60 hours for the complete trip; three ten-hour driving periods, each followed by three eight-hour rest periods, plus a six-hour driving period on the home stretch. The company's trucks powered by the 8V-71's were able to make the same round trip with 29 to 30 hours of driving. Since this obviously would require only two rest periods on the road instead of three it meant, besides the saving of six hours driving time, an additional saving of one eight-hour rest period or a total of 14 hours for the full round trip.

Product view of the two-cycle 8V-71 truck diesel installed in IPT's four new OTR tractors. Engine is rated 290 hp at 2100 rpm.



OOLOGAH DAM

By L. H. HOUCK

ONE of the largest aggregations of heavy construction equipment in the country has been concentrated in the Nowata, Okla. area where 20 construction contractors are building Oologah Dam on the Verdigris River and relocating highways, building new bridges, and modernizing roads.

Oologah Dam now in its final stage, is located 27 mi. northeast of Tulsa, and this job along with a construction package that includes relocating 50 mi. of highway, six new highway bridges, relocation of 112 mi. of pipelines, 111 mi. of telephone lines, 134 mi. of electric lines, five mi. of railroad track, plugging 4,000 oil wells and a few other jobs, adds up to $35,100,000 with some five or more contracts yet to be let. All of the work is under the jurisdiction of the Corps of Engineers, U. S. Army, Tulsa District.

Prime contractor for the second stage of construction of Oologah Dam, which will inundate the birthplace of Will Rogers, noted humorist, is J. A. Jones Construction Co., Charlotte, N. C., with a contract for $5,055,859 for outlet works, spillway and completion of embankment.

Oologah Dam is 4000 ft. long, 129 ft. above the bed of the Verdigris River, and the earth embankment contains two million cu. yds. of materials. Drainage area above the dam amounts to 4,339 sq. mi. and the flood control pool is 32 mi. long and more than three mi. wide. Flood protection will be provided for 93,000 acres, water will be provided for several cities, a steam electric power plant, and for navigation channel for navigation of the Verdigris River.

The dam will provide five public use areas and a 20,000-acre fishing and hunting preserve. It is scheduled for completion in 1962 and the Jones contract was approximately 60 percent completed when visited by DIESEL and GAS ENGINE PROGRESS in late fall. Jones worked through the winter on its concrete structures involving 48,000 cu. yds. of concrete heated during cold weather. They had 1.8-million cu. yds. of borrow for fill to excavate for embankment, 2-million cu. yds. to place in the embankment, 36,000 cu. yds. of rock fill, 35,500 cu. yds. of riprap, expected to move in a new fleet of dieselized dirt moving equipment early in the spring.

For its current work, Jones had a variety of dieselized equipment working. This includes two TS-18 Euclid scrapers with 6-110 GM diesels, a TD-24 International with International diesel; an Allis-Chalmers motor grader with Allis-Chalmers diesel engine, a Caterpillar 112 motor grader, a Caterpillar D7 and D8, two 600 cfm Chicago Pneumatic air compressors with GM 6071 diesels, and a 175-A Michigan loader with 6-71 GM diesel.

Of the 20 contractors involved throughout the area, Steinberg-Boyd Construction Co., Broken Arrow, Okla., had a key spot, with a rock quarry and aggregate production operation in addition to its road and bridge contracts. Steinberg-Boyd holds a $674,983 contract for relocation of State 28, Lightning Creek bridge and Lightning Creek roadway. This contractor subbed some of its dirt work to A. K. McBride, Fort Smith, Ark., holder of a $758,179.50 contract for relocation of U. S. 60 east of Nowata and it in turn subbed 13 items involving rock and aggregate to Steinberg-Boyd.

Steinberg-Boyd is set up to furnish aggregate and riprap rock to other contractors and for this purpose has a quarry equipped with modern and reliable equipment using diesels. Blast hole drilling in the Oologah bed of limestone approved for all jobs in the area, is done with two Chicago Pneumatic 2¼-in. drills mounted on a D6 Caterpillar and supplied with air from a 600 cfm Power-Vane rotary Chicago Pneumatic air compressor with a 6-71 GM diesel.

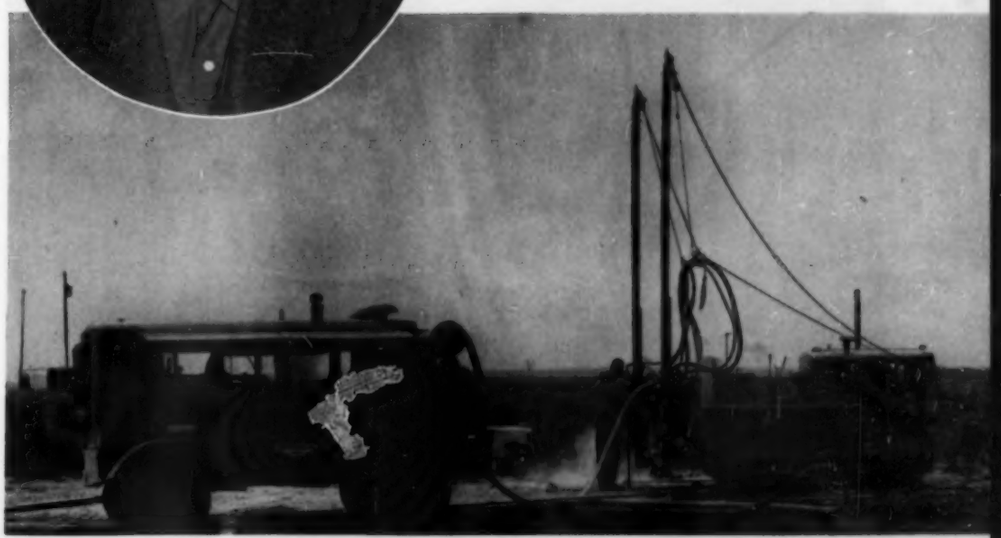
The company's rock plant was an assembly of high production units. Primary was a Cedarapids single jaw No. 2540, with an 8 in. vibrating grizzly with a ME-66 Murphy diesel, a No. 1863 Cedarapids twin-jaw crushing and scalping unit driven by another ME-66 Murphy diesel. Secondary was a Cedarapids Commander with Nordberg cone crusher driven by a GM-6-110 diesel. Conveyor belts were electrically powered by a Caterpillar 75 kw generator unit.

The primary crusher was charged by a fleet of 10 ton rear dump Euclids with GM diesels, which were loaded with a 38-B Bucyrus-Erie shovel, 1½ yd. capacity, with a 6-71 GM diesel. A Michigan 175-A with a 3 yd. bucket and 6-71 GM loaded aggregate into trucks for delivery to jobs and

Steinberg-Boyd's crushing plant was well dieselized. Cedarapids single jaw primary crusher uses an ME 66 Murphy, a 10-ton Euclid with 4-71 GM diesel is dumping; another ME 66 Murphy drives a Cedarapids 1863 twin jaw intermediate scalping and crushing unit and the Cedarapids Commander secondary screening unit is driven by a GM 6-71 diesel. Caterpillar generator plant supplies current to motorized belt pulleys.

P & H 555 35-ton moto-crane, with Waukesha 140 diesel, 80 ft. boom, and 20 ft. jib, was used on the outlet works of the Oologah Dam for handling forms and concrete buckets. Gardner-Denver 600 cfm air compressor with 6-71 GM diesel is between crane and concrete structure. Concrete was poured throughout the winter months, using steam heat.

John R. Soderberg, resident engineer for the Corps of Engineers, U.S. Army, in charge of the dam construction.



Blast hole drilling outfit at the Steinberg-Boyd quarry included this Chicago Pneumatic 600 cfm Power Vane air compressor with 6-71 GM diesel and a pair of Chicago Pneumatic drills mounted on a D6 Caterpillar tractor.

another unit in the quarry was a ¾ yd. Northwest shovel with 4-71 GM diesel.

When the quarry was visited by DIESEL and GAS ENGINE PROGRESS the Michigan was loading a fleet of 11 GMC tandem tractors, with 6-71 GM diesels, pulling 18 ton Clement end-dump trailers, owned by Poteau Truck Co., Poteau, Okla., engaged in hauling aggregate four mi. to the Lyles & Buckner Co., Muskogee, Okla., job, as sub for paving of a section of U.S. 169 under Imperial Paving Co., Oklahoma City. Aggregates were being stockpiled near Talala, where the Lyles batch plant was being erected. Loads were dumped and then picked up by clam on a 1½ yd. Marion with a Caterpillar diesel.

John R. Soderberg, is resident engineer for the Corps of Engineers, Co. Howard W. Penney, is district engineer, Tulsa District. William E. Haynes, is project manager and R. L. Welch, chief engineer, for J. A. Jones. Blue Anderson, executive vice-president Steinberg-Boyd, was in charge of its operations.

Principal Equipment in Use On Main Contracts

Units	Make and Type	Engine Make
Crawler Tractors		
4	Allis-Chalmers	A-C
13	Caterpillar	Cat
2	Euclid TC12	GM (2)
2	International TD24	I-H
Wheel Tractors		
2	Michigan 175A	GM
Scrapers		
6	Caterpillar DW21	Cat
4	Euclid 21-yd	GM
Motor Graders		
4	Allis-Chalmers 45	A-C
8	Caterpillar 12	Cat
Draglines, Shovels, Cranes		
4	Bucyrus-Erie	GM
1	Insley crane	GM
2	Lima ¾-yd	GM
1	Marion 1½-yd	Cat
3	Northwest draglines	GM
1	P & H Moto-crane	Waukesha
Highway Trucks		
11	GMC tandem	GM
Off-Highway Trucks		
8	Euclid 10-ton rear dumps	GM
Air Compressors		
1	Chicago Pneumatic 600 cfm	GM
2	Gardner-Denver 600 cfm	GM
1	Cedarapids rock plant	Murphy (2)
1	Cedarapids rock plant	GM
1	Caterpillar diesel generator	Cat

LIBERTY'S NEW ENGINES SLASH FUEL COSTS

1600 HP Nordberg Spark-Fired Gas Engine Tests At 5837 Btu Per HPH, Leads Texas Plant To 2.81 Mills Per Kwh Fuel Cost

By FRANK HANCOCK*

LED by a new engine with high efficiency, the Liberty, Tex. municipal power plant has cut fuel costs 23 per cent to a new low of 2.81 mills per kilowatt hour. This was the plant average achieved in the complete fiscal year ended September 30, 1959. The last few years have brought a notable expansion and modernization of the city's generating facilities. When Liberty started a new municipal plant with a pair of 200 kw gas engines in 1939, the city had only about 3000 residents and the community served and subsisted on the surrounding farms and ranches. The area already was served by a private utility company and the city entered into competition for customers in a frank effort to obtain power profits to supplement tax income. Today the city carries about half the load including a majority of the residential consumers. Initially the city and company rates were identical but today the city's charges are a shade lower.

Plant expansion followed the classic pattern after World War II with installation of another 200 kw engine in 1946 and a pair of 350 kw units in 1948. Rate of growth received additional stimulation in 1951 when an oil field was discovered and population began to climb. In 1952, a 920 kw dual fuel engine was installed, bringing plant capacity to 2200 kw. But peak load moved up too and it was soon necessary to run the biggest engine to meet the demand peak.

When A. L. Hogan Jr. & Associates, consulting engineers, surveyed the situation, they recommended substantial expansion, not only to provide firm capacity but to turn a major share of production over to newer, more economical gas engines. First step in this program was installation in 1957 of a Nordberg model FSE-138-HSC Supairthermal high compression gas engine. This 8 cylinder unit, with 13 in. bore and 16½ in. stroke, is rated 1600 hp at 450 rpm. It drives an Ideal generator rated 1135 kw, 1420 kva, 3 phase, 60 cycle, 4160 volts.

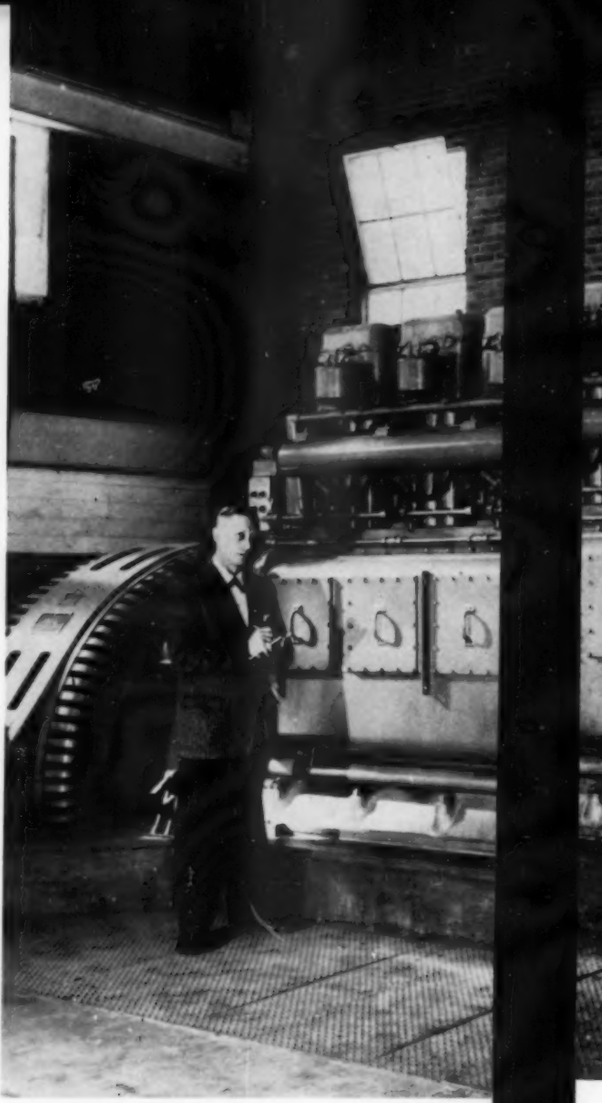
In January 1959 a second Nordberg engine of the same size and type began power production. The contract with the engine builder guaranteed full load performance at 6800 Btu per hp hour. Mr. Hogan conducted a field test in the Liberty plant on February 13, 1959 and recorded full load fuel consumption of just 5837 Btu per bhp/hr, 14.2 per cent better than the guarantee. Also worth noting is the operating efficiency at all load levels. Here are the figures as reported by the consulting engineer:

% Load	Contract Guarantee Btu/Bhp Hr	Field Test Feb. 13, 1959 Btu/Bhp Hr	% Improvement Field Test Over Contract
50	8200	6631	17.1
75	7200	6048	16.0
100	6800	5837	14.2
110	—	5725	—

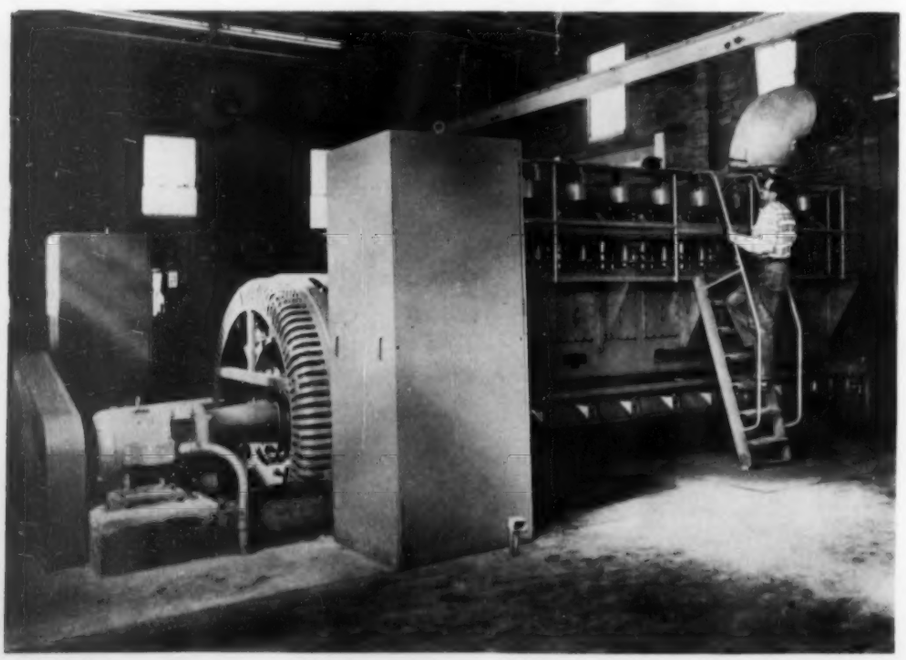
In addition to recording these efficiencies, this 1135 kw engine carried a load of 1320 kw.

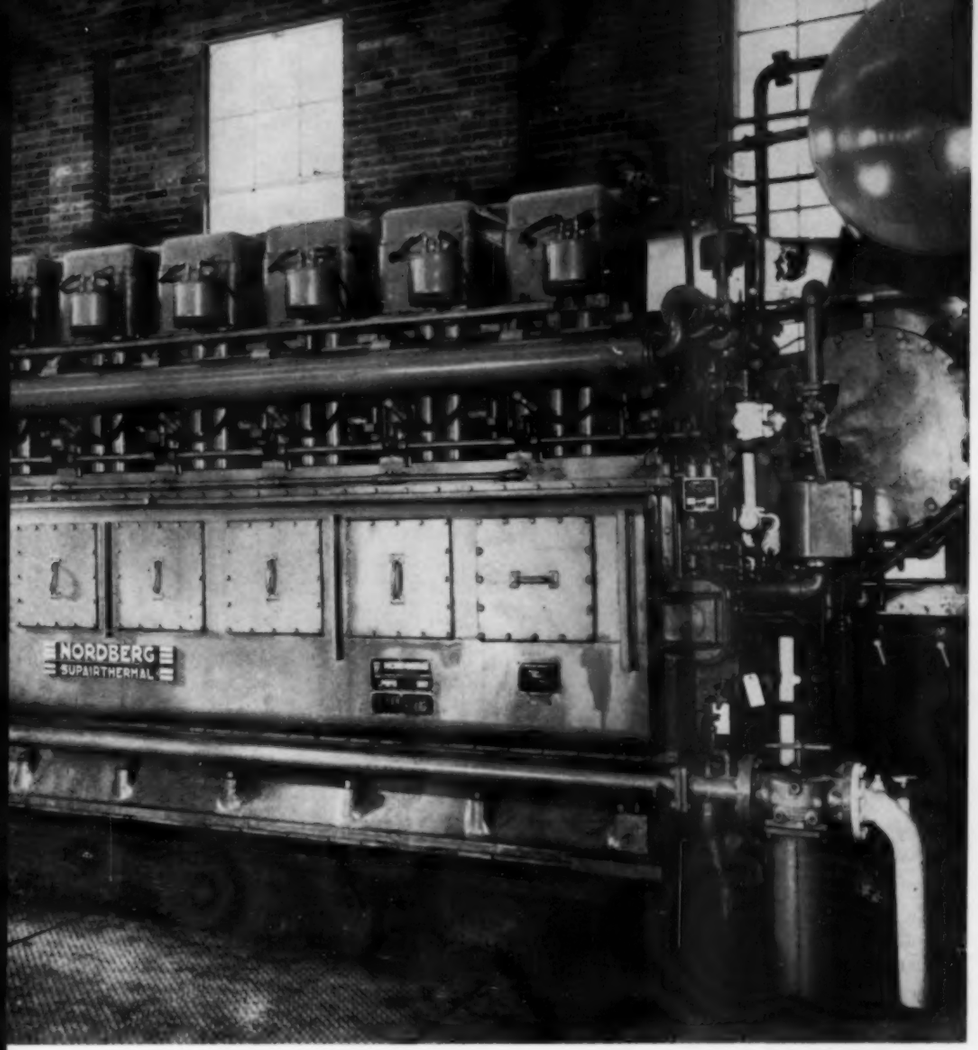
The responsiveness of the engine to load variation and the high thermal efficiency over a wide range are attributed to the high expansion ratio, to variable inlet valve timing which controls air-fuel ratio, and to variable ignition timing. Both of the Nordberg engines are now similarly arranged. Overall plant figures show the improvement in efficiency as the two new engines took over the bulk of the load. In the 1959 fiscal year, the No. 7 engine was the work horse, operating 6096 hrs. Though the No. 8 unit was in service only part of the year, it was on the line for 3657 hrs. Next came the No. 6 dual fuel unit with 1891 hrs., then the pair of 350 kw engines with a combined 2549, and finally the trio of 200 kw units with a combined 479. It is estimated that the two

City Manager, Liberty, Texas



The two Nordberg engines, each rated at 1600 hp, more than doubled the capacity of the Liberty plant.





City Manager Frank Hancock inspects Liberty's newest engine, a 1600 hp spark-fired Nordberg Supairthermal gas engine. Note American Bosch ignition system, Young intercooler, DeLaval turbocharger, Woodward governor, Ideal Electric generator and Fulton-Sylphon thermostatic control.

Nordbergs handled more than 80 per cent of total plant production.

In this last complete fiscal year, the plant generated 8,852,000 kilowatt hours at a total fuel cost of $25,072.68, an average of 2.81 mills per kwh. In the preceding year, the production was 7,645,000 kwh at a fuel cost of $28,011.25, an average of 3.65 mills per kwh. Thus, fuel costs were reduced a substantial 23 per cent.

The plant has paid for successive expansions out of profits, building a valuable municipal property, and showing additional profits which helped pay the cost of city services. In addition to cash contributions to the city general fund, the Light and Power Department installs, maintains and supplies electricity for all street lights for a nominal fee of $3500 a year. The value of the energy alone, at utility rates, was more than $11,000 last year. Free current was supplied to the three sewage lift stations and power supplied to the treatment plant was billed half price. City officials have decided that in the future, the plant should meter and bill for all electricity supplied to other city departments, and use the added profit resulting to increase the contribution to the general fund. The purpose of this change in bookkeeping is to enable both officials and citizens to see clearly the size of the contributions the city gets from its power plant.

Ease of plant operation and engine efficiency can be attributed in large measure to the close automatic control of air, gas, oil and water. To concentrate on the newest installation, air is drawn through oil-bath filters to the exhaust driven turbocharger which discharges through an intercooler to the cylinder inlet valves. Since a supply of cold water for the intercooler is important, a separate induced draft cooling tower, circulating pump and thermostatic valve have been provided for this purpose. A fan-cooled radiator cools engine jacket water circulated through the engine and radiator by a motor-driven centrifugal pump. A similar pump puts water through a shell-and-tube lube oil cooler and another set of coils in the radiator.

Natural gas is admitted to each cylinder through a separate valve controlled by individual actuator pumps. The actuator pump settings and the air intake valves are both governor controlled to achieve optimum air-fuel ratios at all load levels. The actuator oil system includes a separate supply tank, two motor driven pumps, a duplex filter and thermostatic valve. The variable ignition timing device assures maximum operating efficiency over the full load range.

Two panels are located convenient to the new engine. One holds a voltage regulator, switchgear, electric meters, synchroscope and governor controls. The other holds an exhaust pyrometer, alarms with indicator lights, gauges and controls for auxiliary equipment. Plant superintendent is Ray Needham.

Principal Equipment Serving New Engine

Generator	Ideal Electric
Governor	Woodward
Ignition generator	American-Bosch
Cooling water pumps	Allis Chalmers
Radiator	Young
Intercooler	Young
Thermostatic valves	Amot, Fulton Sylphon
Turbocharger	DeLaval
Air filter	American Air Filter
Lube oil	Texaco
Lube oil pump	Viking
Lube filter	Hilliard
Exhaust snubber	Burgess
Exhaust pyrometer	Alnor
Lube oil cooler	Ross

The Liberty, Texas municipal power plant.

NEW MODELS OF CUMMINS NH SERIES

A 250 HP Naturally-Aspirated Diesel with Many New Design Features and Higher Efficiency Engines in 180-195 HP Range Broaden Cummins' Engine Line

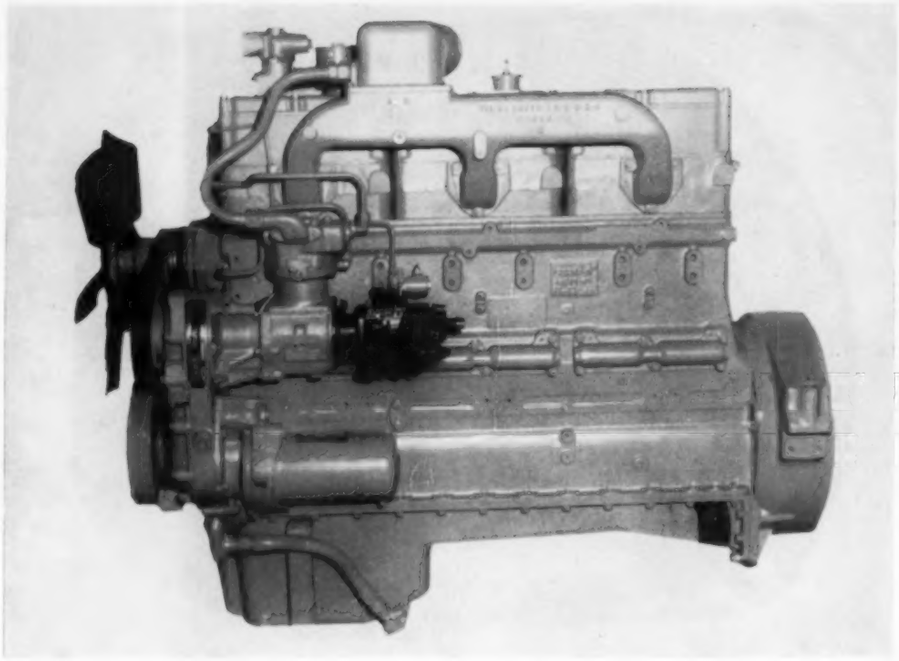
CUMMINS Engine Company has announced the new model NH-250 diesel developing 250 hp and the NHE series for higher operating efficiencies in the 180 to 195 hp area in a move to broaden their engine line for truck operators and other engine users. Both the NH-250 and the NHE models are offered with significantly improved operating economy for specific applications as a foremost feature. The new 250 hp naturally-aspirated NH-250 is designed for western, midwestern and southwestern truckers hauling loads 72,000 lbs. GCW and up. This big displacement diesel attains higher horsepower more efficiently than previous designs through the use of a larger piston displacement. The NH-250 utilizes 855 cu. in. displacement compared to 743 cu. in. displacement for the well known Cummins NH-220 truck engine.

The NH-250 is similar in design to the NH-220, but includes a number of important new features. It is rated at 250 horsepower at 2100 rpm. It is a naturally-aspirated six cylinder engine with 5½ x 6 in. bore and stroke and 685 ft. lbs. peak torque at 1500 rpm. The increased horsepower of the NH-250 means better performance and increased speeds on grades, reducing road time and increasing vehicle availability.

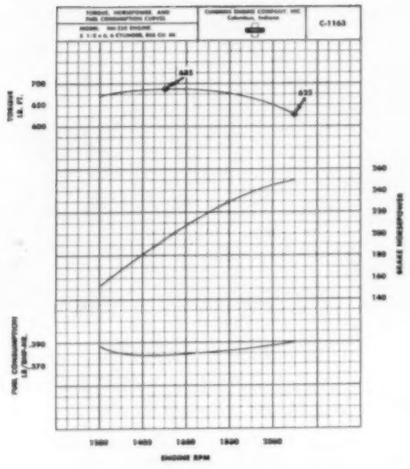
Important new parts of the NH-250 include internal fuel lines and a new type of fuel injector, improved cylinder head studding, internal oil lines, horizontal oil filter, larger valves, heavy-wall cylinder liners, stronger crankshaft, new connecting rods and the Cummins air compressor. Let's take a closer look at some of these design features:

Internal Fuel Lines–Cummins PT fuel system delivers fuel to the injectors through passages drilled in the cylinder head. This new design results in maintenance savings and the elimination of external fuel lines and screw thread connections to the injectors.

Fuel Injectors–The new injectors used in the NH-250 reduce the labor necessary for removal and installation. With the fuel delivered through head passages, the new injectors are merely slipped into position and pulled down with hold-down capscrews. With the previous injectors, an added operation of connecting the pressure and return tubes to each injector was necessary. The NH-250 injector body is a machined piece, instead of a forging as on previous models. Thus, the replacement price for the injector assembly is below the NH-220 price. This new injector was also described in the Cummins V-8 story in the April, 1960 issue of this magazine.



NH-250 engine showing Cummins Air Compressor and PT fuel pump. All fuel and lube oil lines are drilled passages eliminating external lines.



Torque, horsepower and fuel consumption curves of the NH-250 diesel.

Cylinder Head Studding–A significant design feature of the NH-250 is the use of twelve $\frac{11}{16}$ in. diameter hold-down capscrews on the cylinder head. This improves the NH-250 design by: (1) applying even pressure on cylinder liner. This minimizes the possibility of movement and chafing between liner and block, (2) reducing stresses on counter-bore ledge of block through less concentrated loads, (3) improving gasket life by more equalized pressure, and (4) reducing possible head and valve seat distortion due to high stress concentration areas.

Internal Oil Lines–Absence of external lubricating oil hoses, except for suction line from oil pan, is another design improvement. The NH-250 utilizes drilled passages in the block for lubrication and for transfer of oil through oil cooler. Like other Cummins Diesels, the NH-250 utilizes full pressure lubrication to all bearing surfaces.

Larger Valves–NH-250 valves are 1⅞ in. diameter compared with 1¾ in. diameter of NH-220 valves. This 14.5 percent increase in valve area permits

Kenworth COE tractor-tandem trailer unit with 57 ft. of loading space, operated by California livestock hauler Don E. Keith, is powered by 250 hp naturally aspirated Cummins engine. In first 2½ months of operation, tractor put on 26,699 miles using 5,076 gals. of fuel, or 5.26 miles/gal. This NH—250 is one of 30 Cummins diesels operated by Keith.

better breathing for the increased power of the NH-250. Two intake and two exhaust valves per cylinder are used in both NH-250 and NH-220 engines. Stellite exhaust valve face and seat inserts extend life of valves and heads.

Heavy Wall Cylinder Liners—The NH-250 uses cylinder liners with 18½ percent thicker wall section than the liner used with the NH-220. This design reduces corrosion of liner and block.

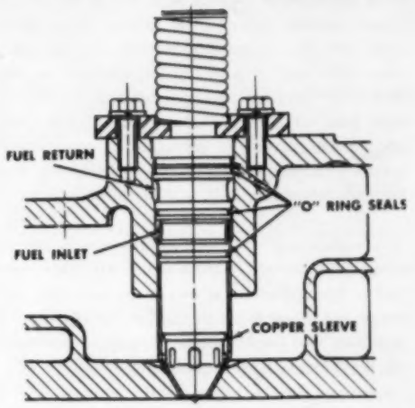
Stronger Crankshaft—A $\frac{5}{32}$ in. increase in the thickness of web on both sides of the connecting rod journal makes the crankshaft more tolerable to variations in load—gives it an increased safety factor over the NH-220 crankshaft. Both crankshafts have 4½ in. diameter, induction hardened main bearing journals.

New Connecting Rod—Tapered end reduces reciprocating weight. Heavier and larger area at parting surfaces of NH-250 rod increases strength and safety factor at this point.

Although the Cummins NH-250 was designed for the power needs of truckers hauling 72,000 lb. GCW loads and up, the advantages of the NH-250 are available to operators hauling lighter loads. In operations where the maximum 250 hp is not required and where special emphasis is given to fuel economy, NH-250 users can reduce the rpm's and the fuel rate to achieve more miles per gallon of fuel. Cummins engineers report a reduction of the NH-250 to 220 hp at 1800 rpm gives an improvement of more than 6 percent in over-the-road fuel economy.

NHE Engines

The NHE series are basically standard NH engines with speed and fuel rate cut back to provide 180 to 195 hp for the specific needs of truckers requiring this horsepower range for their operations. This horsepower requirement is common in trucking, particularly in the midwest and eastern parts of the country. The most important result of the horsepower cutback in the NHE engines is improved fuel economy. According to



Top—with the new head designed with drilled fuel line passages, the injector is easily inserted. Left—Cross-section shows insert injector installed. Pressure and return passages are sealed with "O" rings.

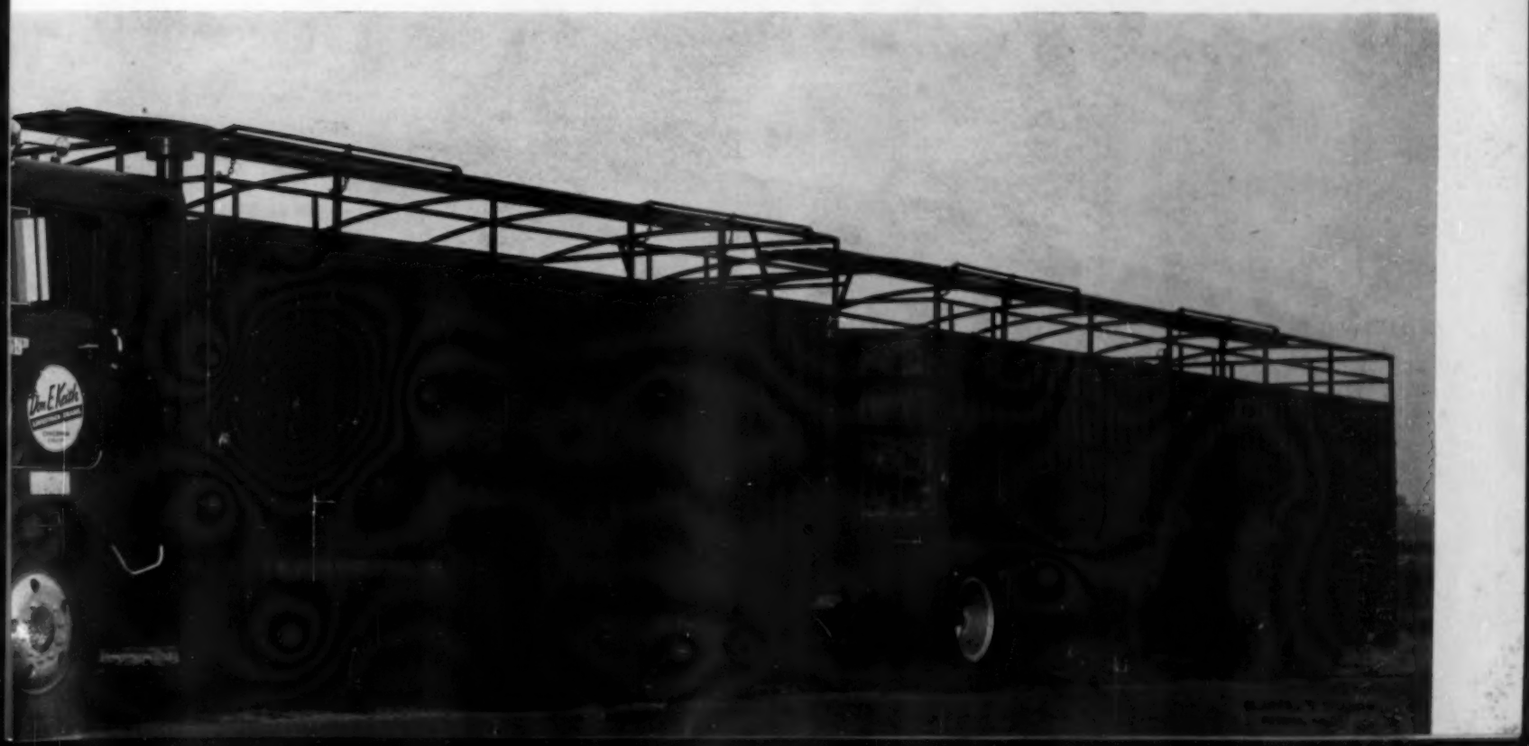
Cummins' engineers, the first step in improving the fuel economy was to reduce the speed of the Cummins NH 220 diesel to 1950 rpm, which cut horsepower to 213 and gave an improvement of 1.8% in specific fuel consumption. Then, the fuel rate was cut back to give only 195 or 180 hp, and in so doing, the specific fuel consumption was reduced by an additional 2.6% at 195 hp and when decreasing to 180 hp, a reduction of 4.9% as compared to the 213 hp fully rated engine was accomplished. With the large 743 cu. in. displacement and installation of such improvements as higher efficiency camshafts, the NHE engines have excellent breathing characteristics.

COMPARATIVE SPECIFICATIONS NH-220 and NH-250

Model	NH-220	NH-250
*Rated Horsepower	220	250
Governed RPM	2100	2100
Torque at Governed RPM	550	625
Peak Torque	606	685
Peak Torque RPM	1550	1500
BMEP at rated HP	112	110
**Fuel rate lbs/BHP/hr.	.392	.390
No. of cylinders	6	6
Bore and stroke	5⅛x6	5½x6
Piston Displacement (cu. in.)	743	855
Compression ratio	15.5	14.9
Length	60$\frac{11}{16}$	60$\frac{11}{16}$
Width	28	28
Height	48	48
Net Weight with Accessories	2435	2590
Lbs. Per Horsepower	11.0	10.3

*Corrected to sea level, 60° F

**Full throttle performance



FLORIDA KEYS AQUEDUCT

A Seagoing Pipeline Carries Fresh Water To The Country's Southernmost City: System Depends on Diesel Engines To Meet an Exacting Demand

By ED DENNIS

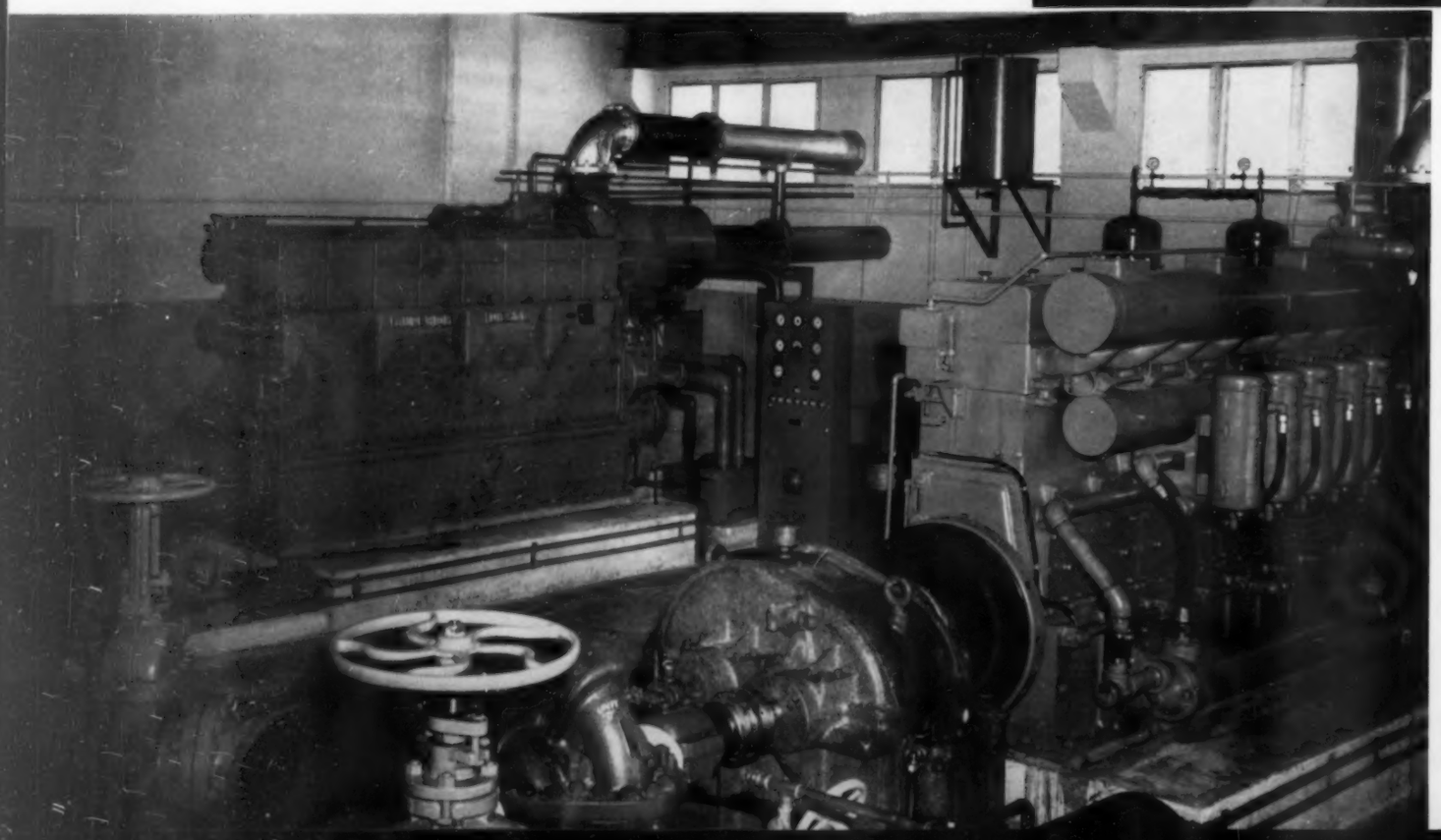
STRETCHING south of the Florida mainland are the Florida Keys, a string of coral rock islands thrown in an arc across the Atlantic and into the warm Gulf of Mexico. Warmed by a Florida sun these tropical isles are linked to the mainland by a highway of steel and cement and their citizens' water needs are supplied by clear fresh water which travels 130 miles via a "seagoing pipeline."

This pipeline is also the lifeline for the 40,000 citizens of the City of Key West and its huge naval base plus the many booming communities on the Keys as it transports upwards to 5-million gallons of fresh water daily to its customers. Key West and its important naval installations along with the various communities on the Keys, were, for more than a century, without any public or private fresh water supply except that which could be obtained by catching and storing rainwater. There are no springs, rivers or fresh water ponds. Shallow wells become badly contaminated with salt water and water obtained from deep wells was so highly mineralized that it could not be made potable by any economical method of treatment.

The Florida Keys Aqueduct Commission, an agency of the state of Florida, was created in 1941 to supply potable water to the Florida Keys. In the same year the commission entered into an agreement with the U. S. Navy Department for construction, operation and maintenance of an aqueduct and water distribution system. The Navy Department agreed to construct a water supply system with an aqueduct extending from near Florida City, along the Keys to Key West.

This eighteen in. pipeline, approximately 130 mi. long, supplies the islands with all their fresh water. The aqueduct is owned by the Navy and water not needed by the naval installations on Key West and Boca Chica is sold to and distributed by the Florida Keys Commission.

Before three new booster stations were built it took about three days for a gallon of water to travel the 130 mi. from the water wells near Florida City on the mainland to Key West. The water left the wells at about 100 lbs. pressure which dropped off to about 35 lbs. by the time it reached Taver-



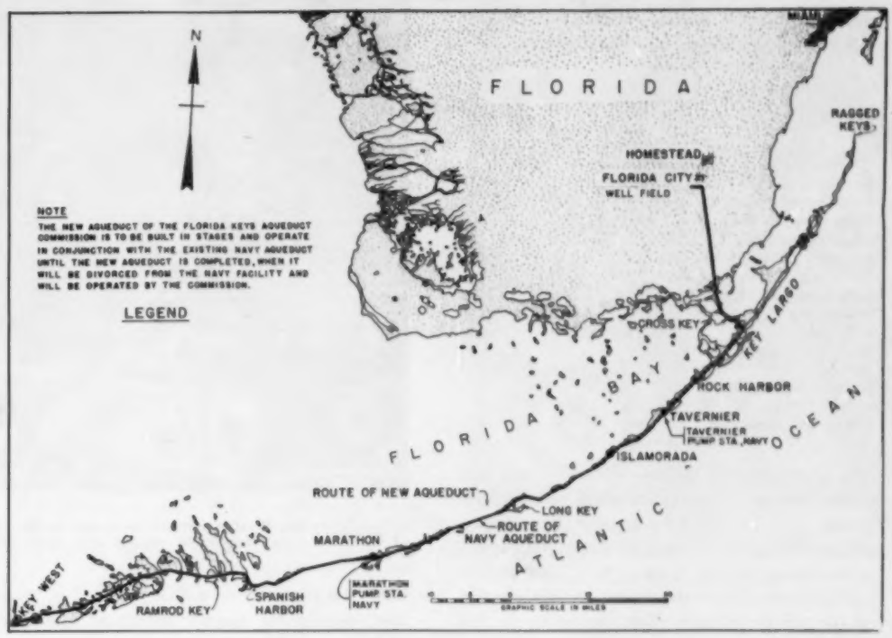
The two model 40-SX-8 Superior diesel engines at the Cross Keys station on the Florida Keys Aqueduct. Engines drive Allis-Chalmers 10x8 in. water pumps through Philadelphia gear increasers. These engines deliver 367 hp at the 600 rpm operating speed. Note Winslow lube oil filters.

The "pipeline that goes to sea" runs along the overseas highway. Highway extends 122 mi. across 40 bridges and 28 keys. Hurricane winds of over 200 mph have been recorded along these Keys.

nier. After repumping at Tavernier it again dropped to a few pounds pressure by the time it reached Marathon, half way down the Keys. At Marathon the pressure was again raised for the final journey to the distributing plant at Key West.

As the contract between the U. S. Navy, which owns this seagoing pipeline, and the Florida Keys Aqueduct Commission, which supplies water to the non-military areas, runs out in 1967, a long range program had to be worked out which will include a new 24 in. aqueduct, several pumping stations and other improvements which will eventually cost approximately $20-million and will require about ten years to complete.

First phase of the program included three new booster stations designed so they will ultimately become part of the permanent water supply of the commission but for the present to operate in conjunction with the present Navy aqueduct. The cost totalled $550,000.



Florida Keys extend in long, thin line southwest from Florida mainland.

These three new booster stations were constructed to tie in with the existing pipe line and were ready for operation the latter part of 1959. Rader & Associates of Miami prepared the engineering report on the new aqueduct and were the consulting engineers.

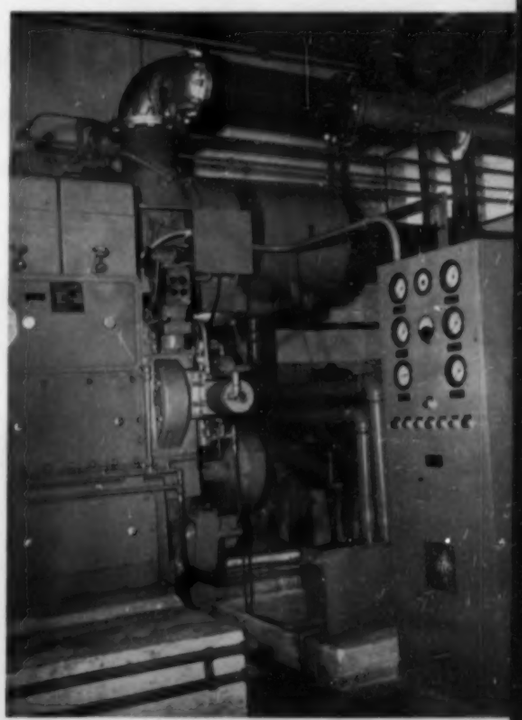
At Cross Key Station, the first of the newly built booster stations on the pipe line going south, two 8-cylinder model 40-SX turbocharged Superior diesel engines were installed. These 8½ x 10½ in. engines are rated 487 hp but normal pump service will demand only 367 hp at 600 rpm and 102 bmep. Each engine drives two Allis-Chalmers 10 x 8 in. S.J. type water pumps in tandem through a Philadelphia Gear Works speed increaser (input 600 rpm, output 1760 rpm).

The two units were installed in the station so that the controls are in an inboard position. Each of the engines also drives a Gorman Rupp water pump rated 90 gpm at 2200 rpm through vee belts.

At Ramrod Key specifications called for two 6-cylinder model 40-SX turbocharged Superior diesel engines each rated 219 bhp at 600 rpm and 81 lbs. bmep, both driving in a clockwise rotation. One Superior drives two Allis-Chalmers 10 x 8 in. pumps in tandem and the other diesel drives two 8 x 8 in. A-C pumps also in tandem. Both have Philadelphia gear increasers and Falk couplings. At Long Key specifications called for the two Superior diesels to be rated at 280 hp at 600 rpm and 103 lbs. bmep driving 10 x 8 in. S.J. type Allis-Chalmers pumps.

Both the six and 8-cylinder model 40 Superior diesel engines used in these new booster stations are of rugged heavy duty construction and are of the four cycle design. All six engines use Elliott turbochargers. Five full flow lubricating oil filters and a shell and tube type heat exchanger are used on each engine. A full pressure lubricating system as well as a constant flow cooling system helps to maintain even engine temperature. The engines have individual two valve cylinder heads with simplified rocker arm construction plus removable wet type cylinder liners and are equipped with oil cooled iron alloy pistons.

Following is a brief summarization of the test report as compiled by Rader & Associates on the



View of front of model 40-SX-8 Superior engine at Cross Keys station. Each engine is equipped with Woodward governor, Air Maze air filter, Elliott turbocharger, Alnor pyrometer, Ross heat exchanger.

official acceptance testing of the Florida Keys Aqueduct Commission booster stations:

Typical Test Runs Sept. 30- Oct. 1, 1959

	Cross Key	Long Key	Ramrod Key
Rate of flow gpm	2500	2210	1960
Engine speed rpm	523	458	411
Engine hp	260	176	104
Specific fuel consumption, lbs/bhp-hr	.372	.367	.392
Guaranteed fuel consumption, lbs/bhp-hr	.384	.392	.452
Station suction pressure, psi	52.5	8.9	15.0
Station discharge pressure, psi	201.5	115.9	88.5
Rate of flow @ full speed (600 rpm)	2870	2900	2860
Total dynamic head, ft	454	424	363

The second part of this first phase included four ground storage reservoirs including two 5-million gallon tanks on Stock Island near Key West, a half million gallon reservoir at East Marathon and a similar one at Big Coppitt Key. This part to cost $500,000. Plans also called for replacement of the old distribution pumping station in Key West with a new one on Stock Island to cost approximately $316,000.

Two model D342 series C Caterpillar diesel engines, each rated 320 hp at 1300 rpm and driving Fairbanks-Morse 10 x 12 in. water pumps with a capacity of 3000 gpm, were installed at the new distribution station on Stock Island.

Diesel engines have been the main source of power for the pumping stations since the pipeline was first constructed and as the Keys are in the hurricane belt diesel equipment is almost a must to assure continuous operation during a tropical storm or hurricane. Since completion of the "overseas highway" and the fresh water pipeline which runs alongside it, Key West along with the other Florida Keys, has been booming.

For the time being the new booster stations will be tied in with the existing Navy owned pipeline and will step the water pressure and flow from 5-million to 6.6-million gpd. The Navy also operates the booster station at Marathon, which is powered by a pair of 300 hp Fairbanks-Morse diesel engines, and the electrically driven station at Tavernier.

Key West is southernmost city in the U.S. It depends wholly on the 18 in. pipeline to supply its 40,000 citizens with water. City is site of a large Naval base and air station.

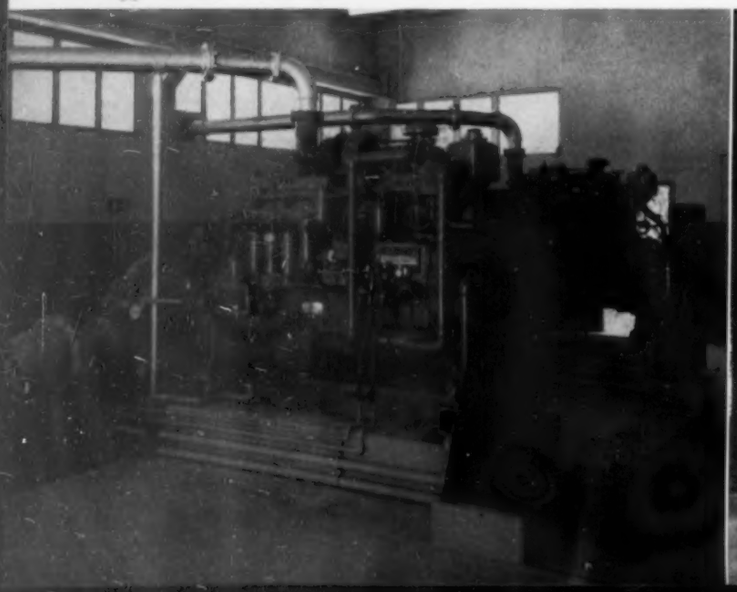
Near Florida City on the mainland the Navy Department operates a 360 acre water well field with a gross capacity of about 9-million gpd and the treatment plant consisting of spiractors and rapid anthracite filters. Power for this station is provided by one 6-cylinder and one 4-cylinder model 32E14 Fairbanks-Morse diesel engines along with Fairbanks-Morse pumps. Six Worthington standby diesel generating sets with 125 kva Westinghouse ac generators are also housed at this station. The new pipeline will be designed to withstand maximum pressure of 280 psi to 330 psi depending on the size of the pipe. Intermediate booster pumping stations will be provided in the future to increase the capacity of the aqueduct and thus insure safe operation within the pressure limits. The entire aqueduct should be completed by 1967 when it is estimated that the commission's daily water requirements will be well over the 5-million gallon mark.

Mr. L. Kirwood, chief quarterman, a civilian, is in charge of Navy facilities at Florida City and the pipeline to Key West. The Florida Keys Aqueduct Commission operates the facilities and distribution of water for the City of Key West and for civilian use along the Keys.

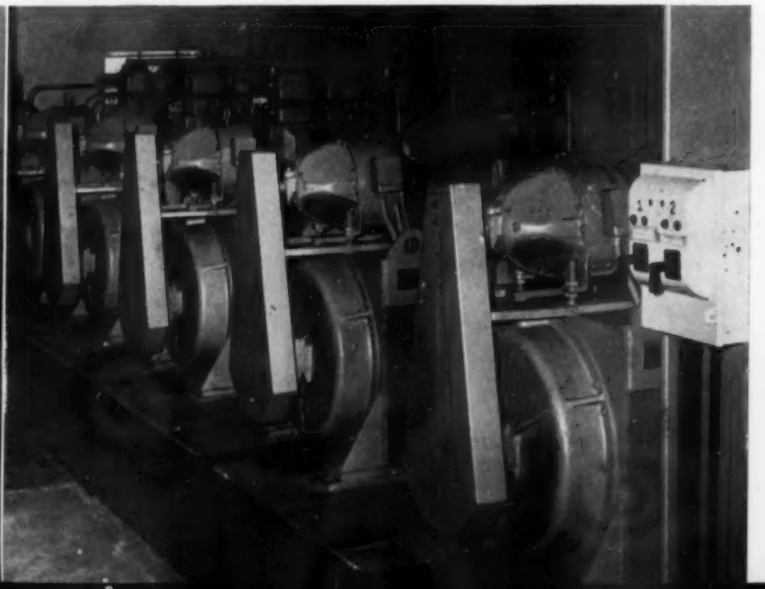
Authors Note: This article deals mainly with the three newly constructed dieselized booster stations. For more diesel information on the Florida Keys see *Florida Keys Co-op,* January 1953 by this author and *Marathon Converts to Heavy Fuel,* March 1957, *Diesel and Gas Engine Progress.*

Principal Equipment Serving Superior Engines

Turbochargers	Elliott
Pumps	Allis-Chalmers
Heat exchangers	Ross
Gear increasers	Philadelphia
Silencers	Kittell
Air filters	Air Maze
Air compressors	Quincy
Pyrometer	Alnor
Governors	Woodward
Gear filters	Cuno
Lube oil filters	Winslow

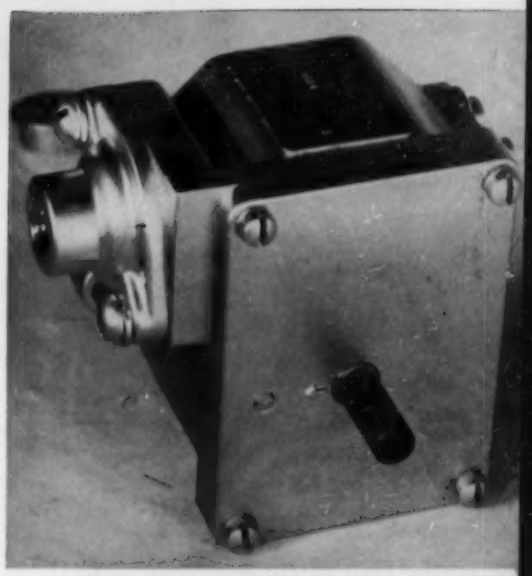


Two model D342 Caterpillar engines are installed at Stock Island station. Engines, rated 320 hp at 1300 rpm, drive Fairbanks-Morse 10x12 in. 3000 gpm water pumps



Six Worthington BB45 diesel engines rated 150 hp at 500 rpm are installed at Florida City well fields and pump station for standby use. They drive 125 kva Westinghouse generators.

SAFETY CONTROL FOR SMALL ENGINES AND COMPRESSORS



Amot model 2800 safety control.

TO provide manufacturers and owners of smaller engines, compressors, and gas turbines with economical protection against low pressure and high temperature, Amot Controls Corp. is now introducing its new safety control model 2800. The model 2800 is a rugged, snap-acting mechanical device similar in operation to the widely used Amot 1476 control. It is basically intended for use on smaller internal combustion engines, but may be applicable to many other types of equipment.

The control features compact size, light weight (1½ lbs.), housing and cover of high-strength aluminum die casting, internal mechanism of SAE4140 precision steel castings, precision needle bearings and rolling pressure diaphragm to eliminate internal friction. The precision castings materially contribute to the lower cost of the unit through increased manufacturing efficiency. All models incorporate a manual stop button for emergency shutdown; and are equipped with an external adjustment for setting the tripping pressure between 5 and 45 psi. The control is factory set at 10 psi but field adjustment may be made by merely loosening the locknut and turning the adjusting screw until the desired setting is reached. It is inherently "fail safe", and requires no source of power other than lube oil, water, or air pressure for its operation.

Presently, three modifications to the standard 2800 control are available. Modification #1 is a reset latch which permits the operator to start the engine without having to hold it in the "run" position. The reset latch automatically returns to a neutral position when the control pressure exceeds the tripping point. Modification #2 is a light tripping spring which has approximately half the normal shutdown force of 20 lb. at 1 in. radius (at beginning of 90° stroke). Modification #3 is a reset and operating lever which is available for those who prefer to purchase this item rather than provide their own.

The model 2800 safety control may be used to protect engines equipped with intake air shutdown valves, shutdown levers on fuel pumps, (rotary distributor and gang type) carburetors, etc. Figure 1 shows a typical installation schematic. The Amot 2230 valve is used as high water or oil temperature detection device which vents pressure from the diaphragm of the 2800 control to trip it. The 1672X pressure valve is shown as a low jacket water or other pressure monitoring control. The 1748 orifice provides a restriction in the pressure line and accelerates the shutdown action in the event of abnormal temperature or auxiliary pressure condition. For air cooled engines, the 2800 control only is required unless high cooling air temperature detection is desirable.

In the usual application in starting an engine, the operator pulls the reset lever into the "run" position, holding it there until lube oil pressure increases to approximately 8 psi above the tripping point. The control will then "latch in" and be ready to actuate. If the reset latch is provided, the operator need only pull the reset lever into the run position, raise the reset latch until it is horizontal then the control can be left unattended. When oil pressure passes the trip point, the reset latch will automatically drop out and the control is prepared to actuate.

Engines equipped with the 2800 control are stopped or slowed down in their normal manner. However, a manual stop button for emergency use is provided. Figures 2 and 3 illustrate several methods of applying the 2800 control to the engine. Figure 2 is a direct linkage arrangement similar to that on the new distributor type fuel pumps. With its 90° trip shaft rotation, it may also be connected to intake air shutdown valves in this manner. Figure 3 shows an application where the safety control is required to overcome the entire force of the fuel pump governor lever. This method is most suitable for small gang pumps whose shutdown force is less than the available safety control force. A better arrangement of this type employs a typical "weak link" action. The fuel pump rack can be moved by the safety control to the "no fuel" position by overcoming only the spring force in the "weak link". The spring holds the entire mechanism to provide a solid action in the movement of the governor, but the safety control is not required to overcome the entire force of the governor lever.

Here are Figures 1, 2 and 3 as referred to in the article.

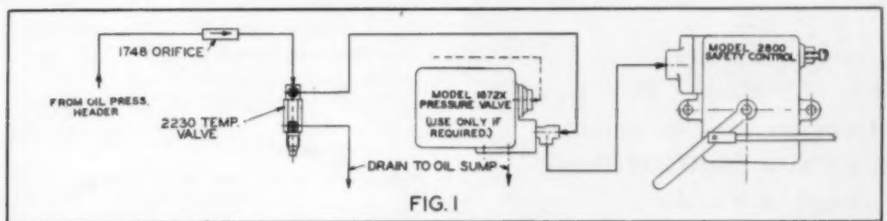


FIG. 1

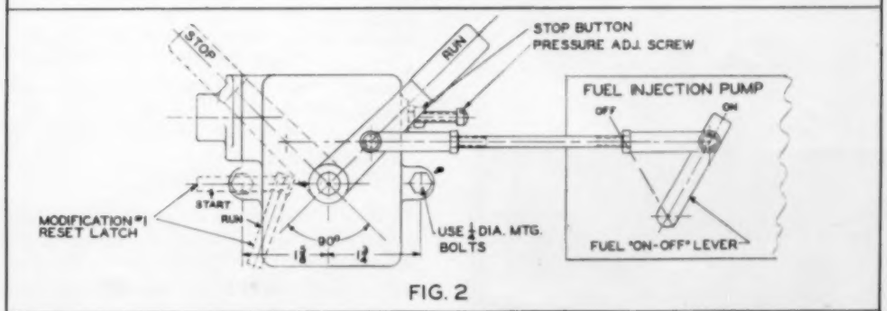


FIG. 2

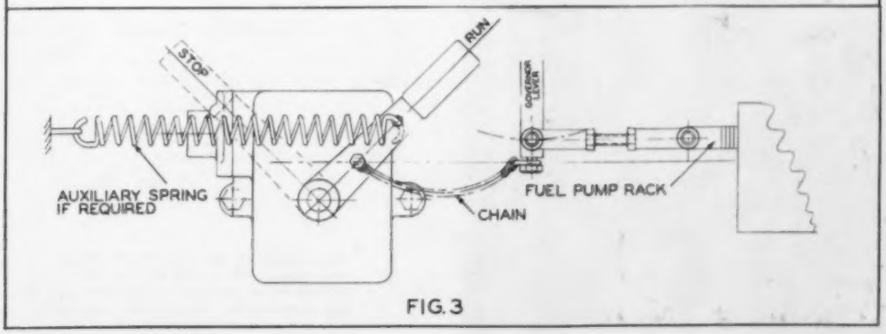


FIG. 3

New Cat D320 turbocharged engine used in Chicago Pneumatic air compressor in stone quarry operation. Engine is one of new line described in accompanying story.

CATERPILLAR'S THREE NEW TURBOCHARGED DIESELS

Industrial Engine Division Introduces Three Compact, High Output Engines in 105-255 HP Range Developed For Broad Equipment Application and Generator Service. Here Also is A Look at New Multi-Million Dollar Mossville Production Facility

By ROBERT E. SCHULZ

MOSSVILLE, Illinois—Here at Caterpillar Tractor Company's Engine Division plant fourteen miles north of Peoria, I had my first look at three of a new series of trim, high output, turbocharged diesels—engines on which Cat officials are banking heavily in their expanded marketing program. Though characteristically identified as the D320, D330 and D333, the engines are totally new. Ranging from 105 hp max. @ 2400 rpm in the D320 to 255 hp. max. at 2200 rpm in the D333, they have a good scope of application primarily for powering construction, well servicing, material handling, and pit and quarry equipment. As packaged generator sets from 35 to 115 kw, they have a wide berth of industrial and marine service. Pointing to the new units, Engine Division Vice President Henry H. Howard stated, "In their design and construction they reflect the continued engineering concept of Caterpillar—an emphasis on compactness, more power output per pound, and a wider range of performance. This is done in the interest of increasing the application base and providing well matched horsepower for the specified equipment."

All three of the new engines are four-cycle, valve-in-head, pre-combustion chamber diesels available either turbocharged or turbocharged and aftercooled. The D320 has four cylinders, 4 x 5 ins. with a displacement of 252 cu. in.; the D330 has four cylinders, 4½ x 5½ ins. with a displacement of 350 cu. in.; and the D333 is a six cylinder version of the latter with a 525 cu. in. piston displacement. Here are the ratings:

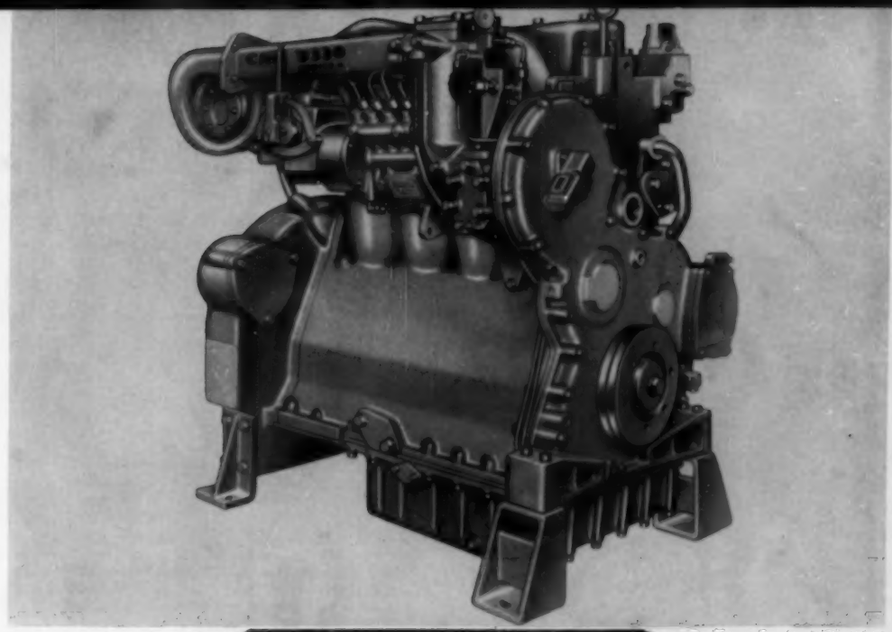
Output	D320			D330			D333		
	T	TA	RPM	T	TA	RPM	T	TA	RPM
HP w/o fan									
Max.	105	120	2400	135	170	2200	205	255	2200
Int.	90	95	2400	115	135	2200	175	200	2200
Cont.	70	75	2000	100	110	2000	150	165	2000
KW w/o fan									
Prime 60 cycle	40	50	1800	60	70	1800	75	—	1800
Prime 50 cycle	35	—	1500	50	—	1500	65	—	1500
Standby 60 cycle	50	60	1800	70	75	1800	100	125	1800

*T —Turbocharged
TA—Turbocharged & Aftercooled

All three of the engines are also built for marine propulsion service and were previously announced in DIESEL AND GAS ENGINE PROGRESS. See the February, 1960 issue for a complete description.

The most important single feature of the new diesels is the overall compactness that Caterpillar has achieved. How this was achieved will be covered in detail, but first let's glance at some of the pertinent figures. The D320 with its 120 hp rating weighs in dry with standard accessories at 1300 lbs., or 10.8 lbs./hp . . . it's 40.56 ins. long; the D330

One of the 26 test cells at the Mossville plant with a 560 hp Cat G397 turbocharged and aftercooled natural gas engine being checked out on the dynamometer.



D330 series A turbocharged and aftercooled diesel rated 170 hp max. at 2200 rpm.

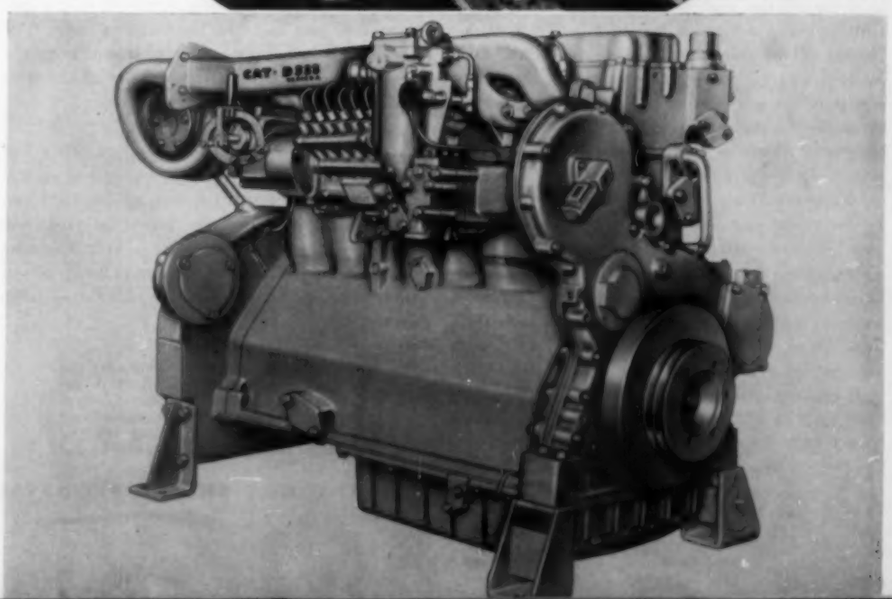
weighing 1630 lbs. and rated 170 hp has a ratio of 9.57 lbs./hp and has a length of 44.6 ins.; and the D333 with a weight of 2130 lbs. and rated at 255 hp. has 8.45 lbs./hp . . . its length is 57.5 ins. A quick glance establishes the fact that these new Cat engines have the "fit" that makes them well suited to many types of equipment once outside of Caterpillar's physical size range. This is particularly applicable in the case of road rollers, compactors, ditchers, lift trucks, farm tractors and others. Applying the engines to rotary compressors, the line-up would be about as follows: D320—250 cfm unit, D330—365 cfm, and the D333—600 cfm.

To gain the desired size and output, the engines were designed for turbocharging from the very outset. In other words, Caterpillar looks at turbocharging as an integral part of the engine and its engineering is hinged on this concept. To further increase the power output they have added aftercooling and designed the new engines with a 18:1 compression ratio. BMEP of the engines with jacket water aftercooling is 170 lbs./in.^{2} and with cold water aftercooling it approaches 190 lbs./in.^{2}. Caterpillar engineers look for the pressures to go higher.

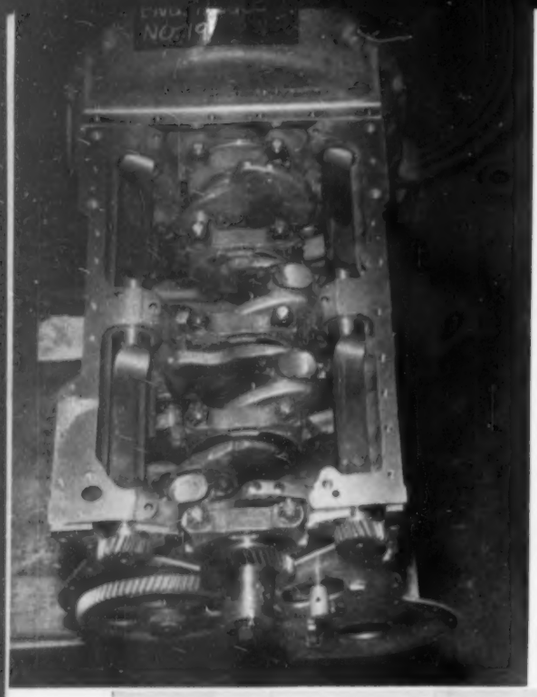
From the drawing board to tested production models was a five year project which started with a thorough evaluation of the capabilities of previous heavy duty engine and component designs to isolate areas of weight reduction, point up component and system refinement, etc. The three engines now in production are evidence of the value of this program and the following major design features apply not only to the D320, D330 and D333, but to other inline turbocharged diesels that Caterpillar will be introducing for other applications as the year progresses.

Turbocharging and Aftercooling—Depending upon the engine model, either an AiResearch or Schwitzer turbocharger is used and to reduce height it is conventionally rear mounted on the exhaust manifold. The dry type air filter is mounted on the air transfer pipe and is connected to the turbocharger with a swivel type O ring unit. When a fresh or salt water aftercooler is applied, it is mounted between the turbocharger and intake air manifold. Aftercooling, previously used primarily with the larger, slower speed diesels, is well applied to the high speed diesel by Caterpillar. With the greater density of air aftercooling provides to the cylinder by decreasing the temperature of intake air, approximately an 11 to 24 percent boost in power output is obtained. The exhaust manifold itself is divided with one section serving two cylinders on the D320 and D330 engines and three on the D333.

Six-cylinder Cat engine coming down the power unit and generator set assembly line at Mossville.



Rated 255 hp max. at 2200 rpm, the D333 is the largest of the newly introduced diesels. Engine uses Schwitzer turbocharger. Note contoured shape of block in cylinder area.

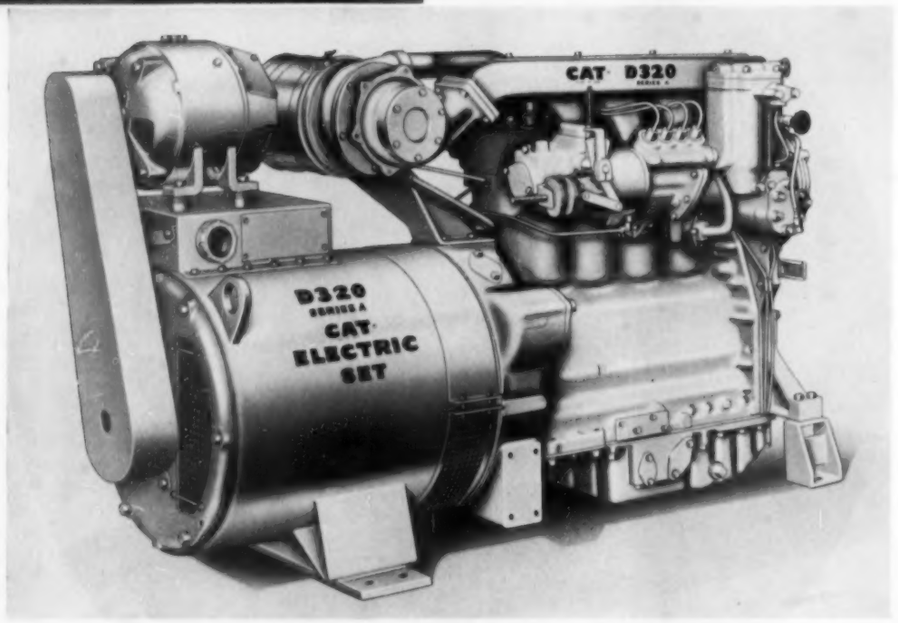


Balanced Operation—One of the special design features of the 320 and 330 is the use of a dual shaft harmonic balancer to eliminate the natural unbalance characteristic of four cylinder engines. The shafts, positioned at opposite sides of the lower block run its full length. They are driven from idler gears off the crankshaft and turn opposite rotation at twice engine speed.

Fuel and Combustion System—Based on the success they have had with other diesels, the Caterpillar precombustion chamber system has been retained as has the low pressure fuel pumps and single orifice injection valves. This system enables the engine to burn economy type fuels with a constant fuel rate and low maintenance costs. The fuel injection pumps are gear driven from the front with the transfer pump driving off the same shaft with right angle bevel gear drive.

Underside of Cat D320 block showing design and position of harmonic balancers, which are driven at twice engine speed by idler gears off the crankshaft.

D-320 turbocharged engine-generator unit is rated 40 kw, 60 cycle at 1800 rpm. Unit is equipped with AiResearch turbocharger, Donaldson air filter and Purolator lube oil filter elements.



Block and Head Design—Shorter and narrower than previous Cat designs, the block is designed to withstand the peak pressures of turbocharging without excess weight. A two wall design is used instead of the conventional three for better expansion and contraction characteristics and simplicity in the low stress areas. This is particularly noticeable in the cylinder area where sections are contoured closely to cylinder shape. To further reduce weight, the water and intake manifolds are an integral part of the cylinder head. In the case of the intake manifold, this design gives the engine trimmer lines and from an efficiency standpoint, gives straight through air flow that allows better combustion and engine breathing. The timing gear train is conventionally located with the camshaft on the left side of the engine. To shorten the engine, a steel cover plate has replaced the gear housing. Standard SAE flywheel housings are used with an SAE #1 on the 4½ in. bore engines and a SAE #2 on the 4" bore.

Cylinder Construction—Two rotating valves per cylinder are used in the new engines and each is of three piece construction with stellite faces and valve seats. Wet liners, heat treated for good cooling capability, are used. Pistons are aluminum with reinforced crowns and benefit from oil jet spray cooling. The pistons take three rings with chromium in the top groove. The top compression rings ride in integrally-cast iron inserts to provide a hard wearing surface for these all important rings. Piston pins are larger due to increased loading and the connecting rods while retaining the I beam shape are stronger than previous designs.

These features primarily give the engine the performance Caterpillar engineers have sought for expanded application. In addition to the increased output from turbocharging, one of the important by-products is the quietness of operation and minimum muffler requirements. With their full blown manifold, the engines have very fine response to changing loads. This was readily apparent from units in dynamometer testing, which all Cat engines go through prior to shipment. All of the engines have excellent torque characteristics. For example, the D333 has a 37 percent torque rise when lugged down to two-thirds engine speed.

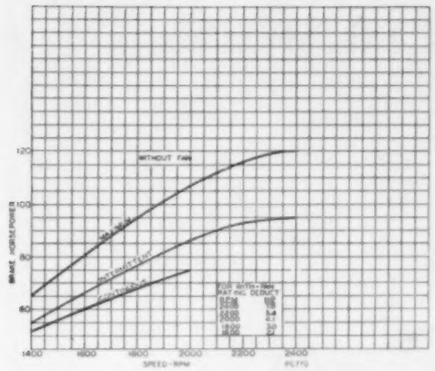
Now here in summary form are the other design specifications:

Crankshaft—This is an induction-hardened and shot-peened steel forging with five main bearings for the D320 and D330, and seven for the D333. Shaft is rifle-drilled and steel-backed aluminum bearings are used. On the D333 the shaft is equipped with a Houdaille viscous vibration damper.

Lubricating System—Positive displacement gear pump and scavenge pump maintain continuous flow of lubricant to 38° tilt in any direction. Full flow filtration is provided and a water-cooled plate type oil cooler is standard and mounted back of the water pump.

Cooling System—A built-in, gear-driven centrifugal pump circulates jacket water and temperature is thermostatically controlled. Water directors control accurately cooling in the area of the combustion chambers. Heat exchanger and expansion tank or radiator cooling systems are available.

Block for a Cat G397 12-cylinder gas engine begins its trip down the V-engine assembly line at Mossville. Second and third from left respectively are L. F. Redenius, manufacturing mgr., and Hugh Boggs, plant mgr.



Performance curve of the D320 engine

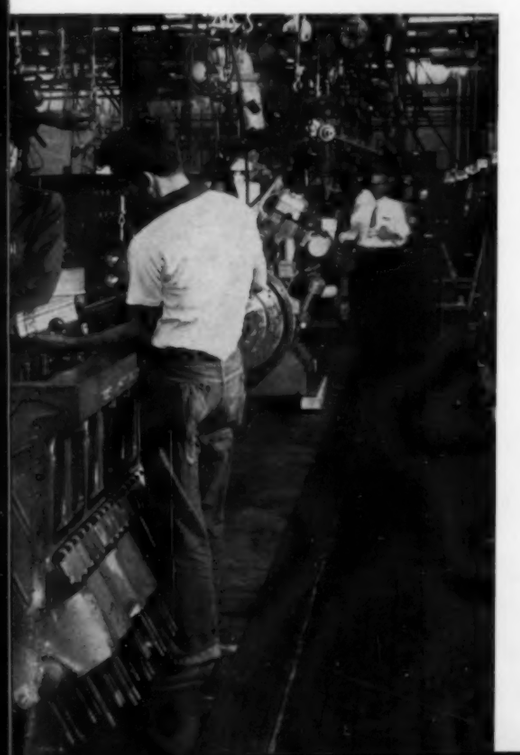
Governor—Caterpillar fly-ball type, spring balanced governor operates through entire speed range and standard speed regulation is approx. 8% with 5% optional.

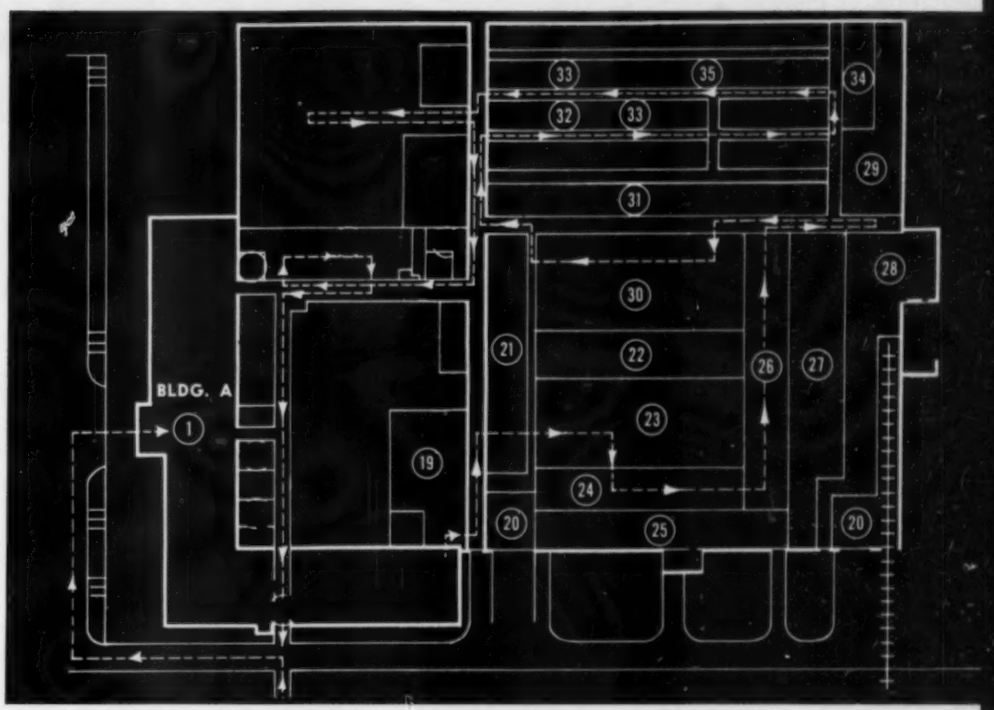
Starting Systems—Four systems are available including Delco-Remy 12 or 24 volt cranking motors; American Bosch hydraulic Hydrotor cranking unit; Schwitzer 15 hp air starting vane type motor; and Cat 17 hp gasoline starting engine.

System Capacities—The following capacities are shown in U. S. Gals.

	D320	D330	D333
Cooling System (engine only)	2.5	3.5	4.4
Cooling System (with radiator)	6.3	7.5	8.4
Lubricating Oil (refill)	3.5	4.	5.5

In previous issues of this magazine we have briefly described the new Caterpillar industrial engine manufacturing facility at Mossville, but based on my recent trip let's take another look at the multi-million dollar plant that some have referred to as "Power City". Just two years in building, the plant began operation in July of last year. It covers



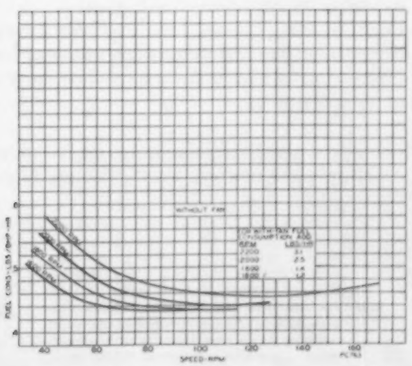


Layout of the Mossville engine plant. The legend is as follows: 1. Entrance, 19. Receiving & inspection, 20. Truck dock, 21. Basic engine storage, 22. Jobbing floor, 23. Engine assembly line No. 1, 24. Final sheet metal assembly & inspection, 25. Wash & paint booths, 26. Engine test, 27. Engine storage & shipping, 28. Export boxing, 29. Steel stores, 30. Engine assembly line No. 2, 31. V-engine block, flywheel and housing line, 32. Special parts machining, 33. Special parts fabrication, 34. Torch and saw area, 35. V-engine base line.

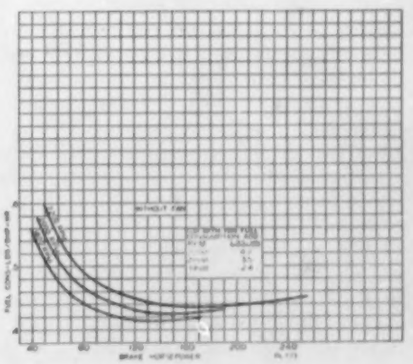
approx. 13 acres with 463,400 sq. ft. of floor space in the works proper and 88,200 sq. ft. of office space. This is headquarters for the entire Engine Division staff, however from an engine research engineering and production standpoint it represents about one-fifth to one-sixth of total capacity . . . the balance in Peoria and San Leandro, Calif. Mossville is set up with two full production lines, one for assembly of all attachments such as torque converters, marine gears and generator sets; the other for assembly of the full Cat V engine line plus attachment assembly. The latter is unique in that it is probably the only one of its type on which engines of this size to 750 hp are produced on a moving assembly line basis. Both lines, each 320 ft. long, carry directly into the sound proofed testing area composed of 26 test cells. Here the V engines undergo five to six hour dynamometer testing while the generator sets, and other power units are checked out with their special equipment. Eleven different setups are installed for electrical testing including switch-gear and air-cooled load banks on the roof which provide a range of 110 to 7200 volts. From the testing area, the units may be routed to the rework floor, but are generally dollied directly onto a continuous chain which takes them through the paint spray booths and to the shipping area.

From an exterior standpoint the engine plant is distinctively modern and this contemporary design is used throughout the main offices as well as the other service facilities. The plant has its own source of water, heating plant, emergency power plant, cafeteria, theatre, etc. Good reason, perhaps, why it can be called "Power City".

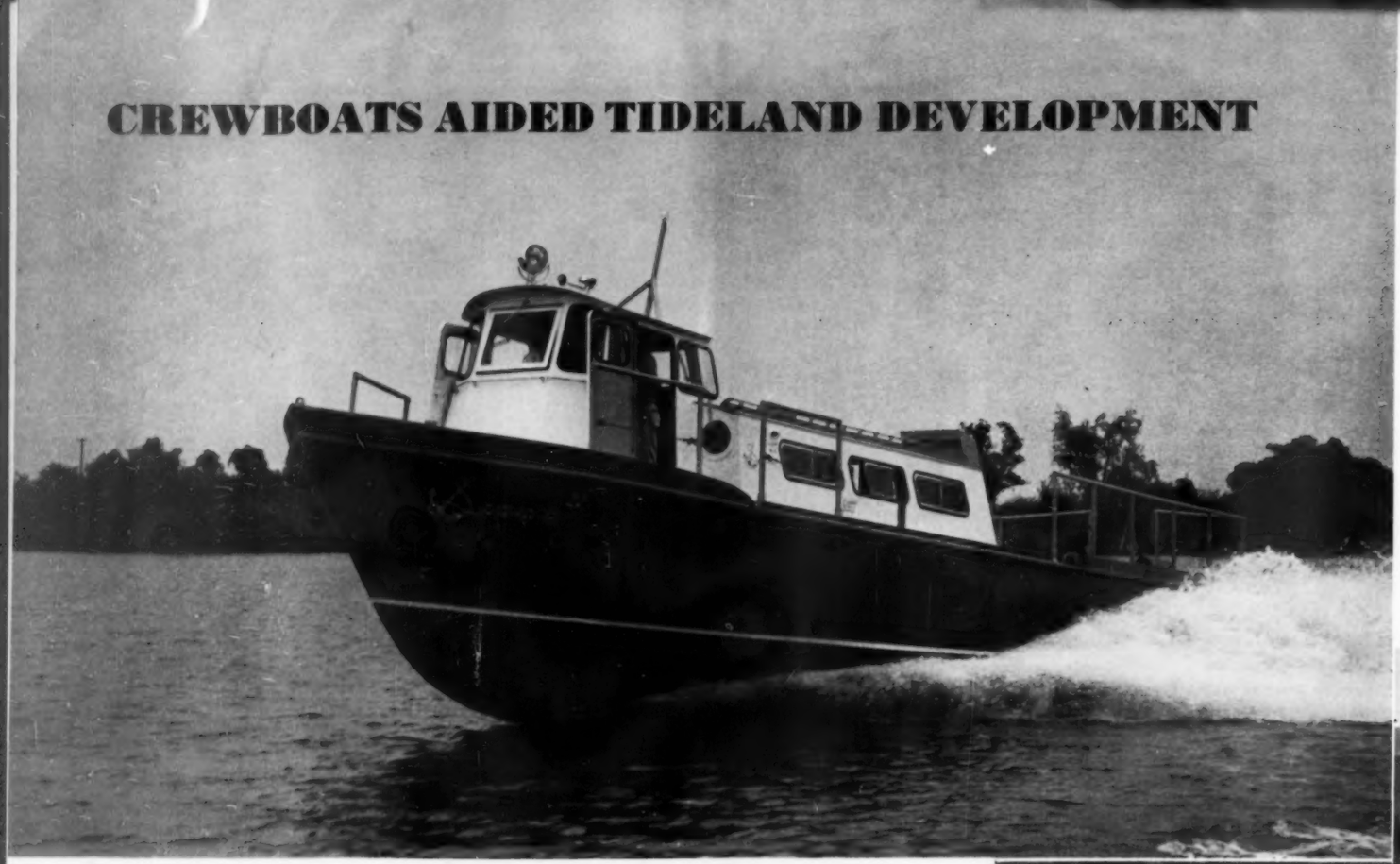
Performance curve of D330



Performance curve of D333



CREWBOATS AIDED TIDELAND DEVELOPMENT



LITTLE known outside the oil industry are the high-speed personnel launches or "crewboats" used to transport workers and materials to and from drilling sites located over water and in more remote areas of the tidelands. Without these dependable and rugged boats, oil wells could not be drilled offshore in the Gulf of Mexico and in the bays and bayous along the coast or in Lake Maracaibo, Venezuela and the Persian Gulf.

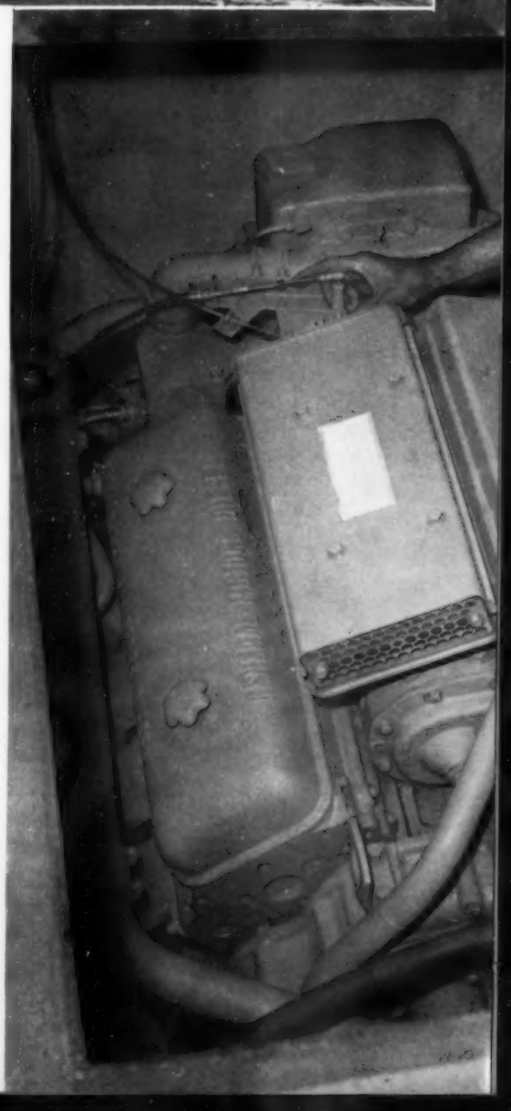
The evolution of the crewboat began in the years just after World War II when geologists began probing the now famous tidelands in hopes of finding oil deposits. The most formidable obstacle in the way of developing the isolated new fields was that of transporting equipment and workers to the offshore drilling sites.

The problem was resolved by the invention of specialized equipment, the likes of which had never been seen in the oil industry. Entire drilling rigs—self-contained units carrying everything from the drilling derrick to the generators and living quarters for the crews—were constructed on giant barges fitted with specially designed tanks which enable them to be floated to a drilling site and then sunk to a shallow bottom and anchored in place. But because of the tremendous distances which men and equipment had to be moved, the industry found itself in something of a transportation dilemma. In early attempts to solve the problem, most oil companies purchased or leased a small fleet of cabin cruisers, sports fishing boats and even shrimp and oyster luggers. These boats performed a Herculean task but were unsuited to the demands placed on them. In the interest of speed and expediency, floating equipment frequently is subjected to rough handling and the wooden hulls simply couldn't stand the gaff. Safety was another problem. It became commonplace to read news stories about crewboats blowing up from gasoline explosions.

This was the background against which the modern highly specialized crewboat was developed. One of the pioneers in this field was the George Engine Co., Inc., of Harvey, La., a distributor of GM Detroit Diesel engines and among the largest sellers of marine diesel engines in the U.S. Although primarily engaged in the diesel engine business, the corporation has for many years worked closely with Louisiana ship yards in powering and improving the design of crewboats and in selling and financing such boats.

As the diesel engine came in and gasoline engines went out of crewboats, so followed development of steel hulls to replace those of wood. Corrosion, one of the biggest difficulties of steel hulls, was minimized by development of a system of "metallizing" in which the completed steel boat is sandblasted of all rust and then treated with a galvanizing coating of molten zinc sprayed onto the hull in an acetylene flame.

Coincident with development of the all metal diesel equipped crewboat was the increase in size



One of a pair of GM series 71 V-8 engines installed in the crewboat. Engine drives 24 in. propeller through Allison 1.5:1 marine gears at maximum propeller speed of 1530 rpm.

Roaring over Bayou Teche near Berwick, La., *Semarca 27* registered 36.92 mph in speed trials over a measured mile course. Power comes from a pair of General Motors series 71 V-8 engines which develop 308 shp at 2300 rpm.

and range of these seagoing workhorses. Whereas the earliest wooden crewboats measured less than 30 ft., boats built today range upwards of 50 ft. Speeds have also been increased as have seagoing qualities. An example of the latter was the 2000 mi. ocean voyage undertaken in June, 1959 by a pair of 45 ft. crewboats sold by George Engine Co., to Tidewater Marine Service, C.A., of Maracaibo. The journey was successfully completed in 14 days despite the fact that none of the seven man crew had prior seagoing experience. The achievement was made more remarkable by a tropical storm which buffeted the boats with 70 mph winds while they were transversing the treacherous passage through the Straits of Yucatan. (See DIESEL AND GAS ENGINE PROGRESS, March 1960)

Recently George Engine announced the sale of a 50 ft. all-aluminum boat, the *Semarca 27*, which reached a speed of 36.92 mph over a measured one-mile course during trial runs in Bayou Teche at Berwick, La.

Constructed by Sewart Seacraft, Inc. of Berwick and powered by a pair of General Motors Series 71 V-8 engines, *Semarca 27* was built to the order of George Engine for sale to Tidewater Marine Service, the same company that had previously purchased the two ocean spanning 45-footers. Tidewater Marine is a major water transportation operator on Lake Maracaibo.

The contract was conditioned on the vessel's ability to attain a top speed of at least 35 mph on Lake Maracaibo. This was some three mph faster than any conventional diesel boat of this size had ever before attained on the big Venezuelan lake. "After considerable study," recalls H. F. Colby, George Engine's executive vice-president, "we decided the hull and cabin would have to be contructed entirely of aluminum to keep the gross weight as low as possible. For power, we chose two of the new GM series 71 V-8 engines, each weighing 3130 lbs. and developing 308 shp at 2300 rpm. Every weight saving device was incorporated into the design and specifications including the use of stainless steel exhaust tubing.

Final calculations before construction started gave every indication that the vessel would reach 36 mph in Louisiana waters. But there was concern about the results of a Lake Maracaibo test because boats almost always test out two to three mph slower there due to differences in fuel and ambient temperatures. To help overcome this problem, Sewart engineers designed special forced ventilation ducts and incorporated them into the engine room structure to assure lower air temperatures in these compartments.

Although minor changes were made in the design of the hull's planing surface, in general, the shape used was the conventional Sewart bottom. The engines were equipped with 1.5:1 reduction gears turning 24 x 30 in. three-blade Michigan Dyna-Jet propellers, mounted on two in. Monel shafts.

Final domestic tests following completion were made over a measured mile on Bayou Teche at Patterson, La. With full fuel tanks, a fuel load of 250 gals., and four men aboard, the maximum speed was 36.9 mph. At 2150 rpm, the speed was 33.6 mph; at 1950 rpm, speed was 30.5 mph. Stop watches indicated a speed of 19.7 mph at 1350 rpm. Surface air temperature during these tests was 79 degrees F with winds of 8-10 mph across the course at right angles. Boat displacement was

The wheelhouse of *Semarca 27* is at the bow where the pilot has 360 degree visibility in all directions through large safety glass windows. Windshield is ventilated for tropical service and aluminum doors on either side can be dogged down in rough weather.

22,000 lbs. and the planing angle was 2.5 degrees.

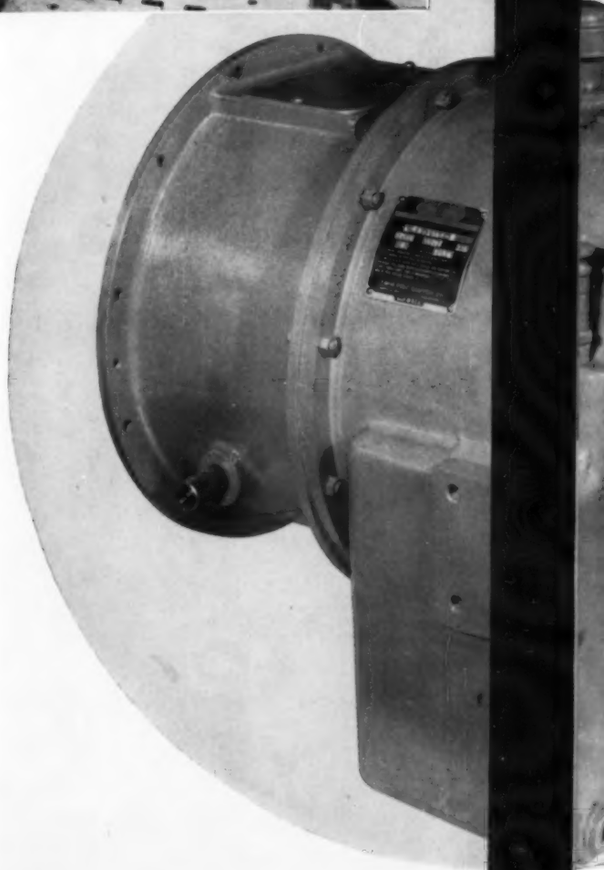
Final acceptance tests were conducted on Lake Maracaibo on October 30. The day was typical for Maracaibo in the Fall with temperatures of 90 degrees and winds of 12-15 mph. The one-mile course was northeast to southwest and return. All time and speed checks were made by independent observers who clocked the mile in one minute and 42 seconds in each direction for a speed of 35.29 mph at 2300 rpm. Ten passengers were aboard during the trials. One long trial test was made. On a 35 mile run down the center of Lake Maracaibo with full fuel tanks and 18 passengers, an average speed of 32 mph was obtained at 2100 rpm.

Accepting delivery of his speedy 50 ft. crewboat is John Laborde, left, president of Tidewater Marine Service, C. A. of Maracaibo, Venezuela. Laborde is shown with H. F. Colby, executive vice-president of the George Engine Co. of Harvey, La. sellers of the *Semarca 27*. To Colby's right is Fred Sewart, president of Sewart Seacraft, Inc. of Berwick, La., the builders, and Ken Hidalgo, vice-president of Sewart Seacraft and naval architect who designed the boat.

NEW TORQUE CONVERTERS FOR EXCAVATORS

Twin Disc Develops New Model C Line of Torque Converters Available in Three Sizes to 650 lb-Ft. And Featuring Boom-Lowering Freewheel

By DOUGLAS SHEARING



LESS than twenty years have elapsed since the first hydraulic torque converter was installed on a crane. Today one of every three cranes, shovels, draglines, backhoes and clamshells purchased is equipped with torque converter drive. Here are some of the reasons for this increasing popularity:

1. A torque converter permits the excavator engine to operate at nearly constant governed speed while developing maximum horsepower. When the shovel bites in, engine speed remains high, permitting more horsepower to be delivered to the deck machinery. This is in contrast to a conventional drive where the engine is pulled down in speed as soon as a heavy load reduces machinery rpm.
2. The converter permits gentle handling and accurate positioning of heavy loads through use of the engine throttle alone. This advantage is especially important on such jobs as setting steel or heavy machinery.
3. Experience has shown that smooth converter power reduces peak loads throughout the drive train because part of the "shock power" is dissipated in fluid slip rather than in clutch linings.

Clutches can be engaged more quickly because the converter absorbs energy that would otherwise produce clutch "jerk."

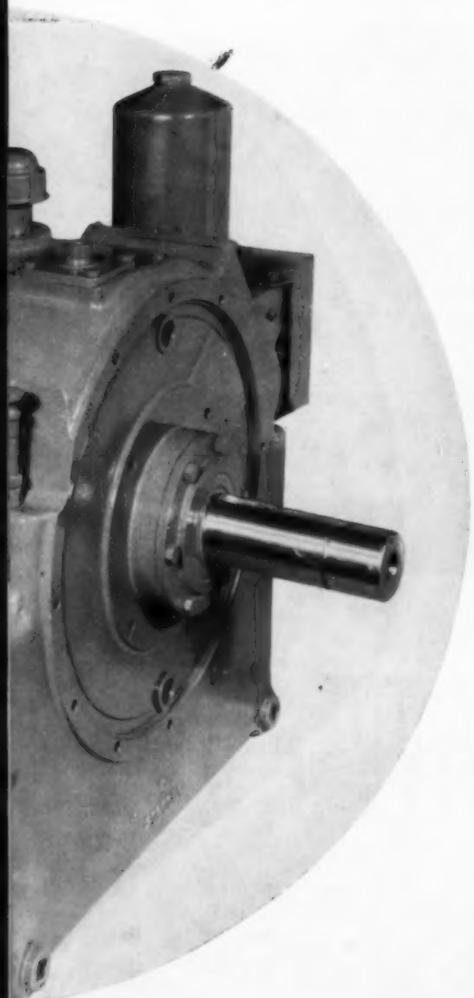
4. The fluid connection between the power unit and driven parts smooths out shocks and jolts. No sharp impact loads pass through the converter, either from the engine to the deck machinery, or vice versa.

New Single-Stage Model C

To extend the application range of its single-stage torque converters, Twin Disc Clutch Co. has developed a new model C line. They are available in three sizes: 1300 series for input torque capacities up to 350 lb-ft.; 1500 series standard duty for capacities up to 450 lb-ft.; and the 1500 series heavy-duty for capacities up to 650 lb-ft. A front-end disconnect clutch is standard on all three series. The 1300 series has an 11 in. single-plate clutch while both 1500 series units have an 11 in. two-plate clutch. These clutches fit standard SAE over-center engine flywheels. Both the 1300 and 1500 series in the model C line have five interchangeable impellers. The blades on these impellers vary with respect to number and pitch so that each has a different torque absorption capacity. This Twin Disc feature insures correct matching of converter to engine and also permits engine horsepower delivery to be increased at a later date without dimensional changes in the torque converter package. As in other Twin Disc single-stage units, the impeller, impeller cover and turbine are precision aluminum castings. The reactor member is a fabricated assembly of steel air-foil section blades with heavy stamped steel shells. Stationary housings are of conventional grey iron.

Here is a Twin Disc series 1500 torque converter installed on Lima 44 crane and powered by Cummins model J diesel.

Twin Disc model CO torque converter equipped with boom-lowering freewheel and standard front-end disconnect clutch.



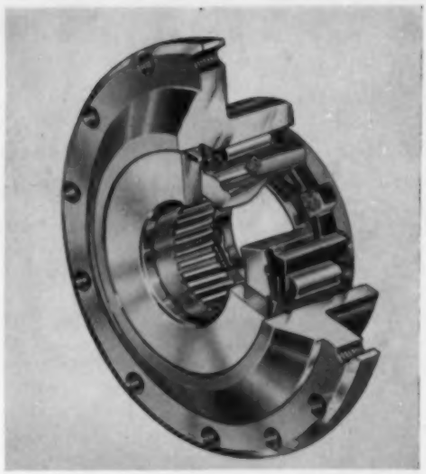
Boom Lowering Freewheel

Of special interest to excavator operators is in an optional feature announced by Twin Disc for its new line of model C single-stage torque converters. Model C converters can be furnished with a boom-lowering freewheel mounted between the impeller and the turbine. The freewheel's operation is similar to that of freewheels used on converter-equipped tractor engines for starting the tractor by pushing. Converters with freewheels are also used in trucks for downhill braking. The heavy-duty cam-and-roller freewheel permits the converter to function like a straight mechanical drive when the boom is lowered. As the boom begins to fall of its own weight, it causes the output shaft connected to the turbine to rotate in reverse direction. As soon as turbine speed exceeds impeller speed, the driven member becomes, in effect, the driving member. Control by means of the engine throttle then becomes impossible and the load is apt to run away.

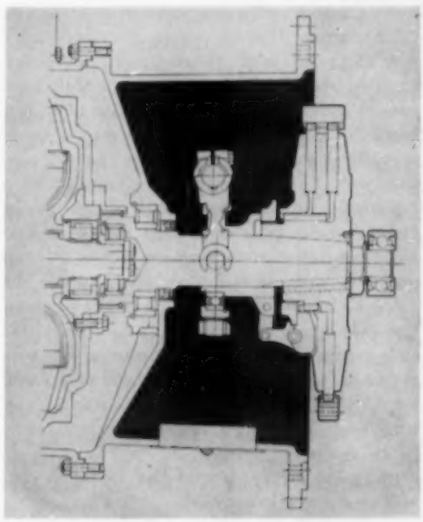
The freewheel prevents such an overspeed situation. Whenever the turbine tends to rotate faster than the impeller, the freewheel locks the two together. In this way the freewheel duplicates the action of a conventional friction drive by using engine friction as a brake in lowering the boom. When equipped with this optional freewheel, model C converters are designated, model CO.

Reduction Gear for High Speed Engines

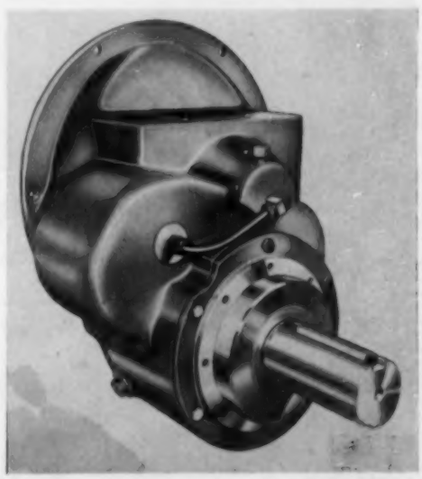
For shovels and cranes using high-speed engines but requiring low output shaft speeds, Twin Disc makes available a 2:1 ratio output reduction gear. This gear can be bolted directly to the rear of any model C or CO converter, since these units have a common housing which is provided with a pilot and mounting face for the gear housing. The reduction gear is capable of carrying output shaft side loads and can be mounted in the field without design change. Its use obviates the need for redesigning the deck machinery when a shovel or crane is repowered with a high-speed engine. When the optional reduction gear is specified, the letter, G is added to the model designation.



Optional on the 1300 and 1500 series converters is this boom-lowering freewheel for shovel and crane applications.



Cross section of Twin Disc front-end cut-off clutch is shown left in this drawing. Single or two-plate clutches are used depending on the input torque.



Output reduction gear for installations using high-speed engines but requiring low out-put shaft speeds.

GAS TURBINES FOR PIPELINE TRANSMISSION

Here is the Paper Presented by Mark J. McDonough* at the 1960 ASME Gas Turbine Conference in which is Compared the Operating Characteristics of a Two-Shaft Turbine with a Single-Shaft Turbine for Pipeline Service

THE gas turbine is playing an ever-increasing role in the expanding natural gas transportation industry. In the brief span of 10 years, the gas turbine has advanced from an experimental status to an accepted, proven prime mover for pipeline use. Coupled to a centrifugal compressor, the gas turbine provides a low-cost, reliable prime mover for gas transmission.

There are many and varied types of gas-turbine cycles. In the more complex cycles involving intercooling, reheat and regeneration, cycle efficiencies can be attained that are comparable to any other type of prime mover. However, in the pipeline industry, where low installed cost is one of the most important considerations, only two types of gas turbines should be considered. These are the open-cycle, single-shaft unit and the open-cycle, two-shaft unit. Either cycle can be equipped with a regenerative heat exchanger which utilizes the hot turbine-exhaust gases to preheat the combustion air. Regeneration provides approximately 25 to 40 per cent improvement in cycle efficiency over the simple-cycle unit. The efficiency gain of a regenerative cycle over a simple cycle is a function of the cycle pressure ratio. For a given turbine-inlet temperature, a low-pressure-ratio cycle will show a considerably larger gain in efficiency resulting from regeneration than will a high-pressure-ratio cycle. This is owing to the fact that the lower temperature from the axial compressor and the higher temperature from the turbine provide a higher temperature differential to return heat to the cycle.

The choice of a regenerative-cycle or a simple-cycle gas turbine for a given application is an economic evaluation. It is a question of whether the higher first cost of the regenerative cycle can be offset by the decreased operating expenses and is a function of fuel cost and load factors. For any given application, studies can be made to determine the break-even point. This is the point where fuel cost and load factor are such that the operating expenses of the regenerative cycle are equal to the operating expenses of the simple cycle. Frequently, the simple cycle is the proper choice for stations near the gathering fields, while the regenerative cycle is the proper choice for stations near the delivery end of the line.

While the choice between simple and regenerative cycles is purely an economic one, the choice between a single-shaft and a two-shaft unit depends entirely on the combined performance characteristics of gas turbine, driven compressor, and pipeline. While both types of gas turbines provide relatively low installation costs and low operating costs, the single-shaft unit is decidedly the better of the two in relation to these costs. Thus the single-shaft unit should always be the choice for applications where the flexibility requirements are satisfied. A careful review should, therefore, be made as to the gas line flow requirements and where possible, employ the simplicity of the single-shaft design. Since the author's company builds both two and single-shaft gas turbines, it is the intent of this paper to evaluate the merits of both types.

Turbine Descriptions

Fig. 1 shows a cross-sectional view of an 8000-hp single-shaft gas turbine suitable for direct connection to a pipeline compressor. The five axial-flow turbine stages are directly connected to the axial-flow compressor consisting of 16 stages. The power

*Design Engineer, Industrial Gas Turbine Dept., Westinghouse Electric Corp.

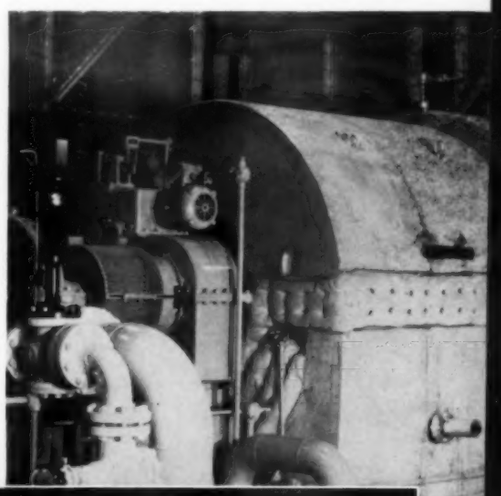
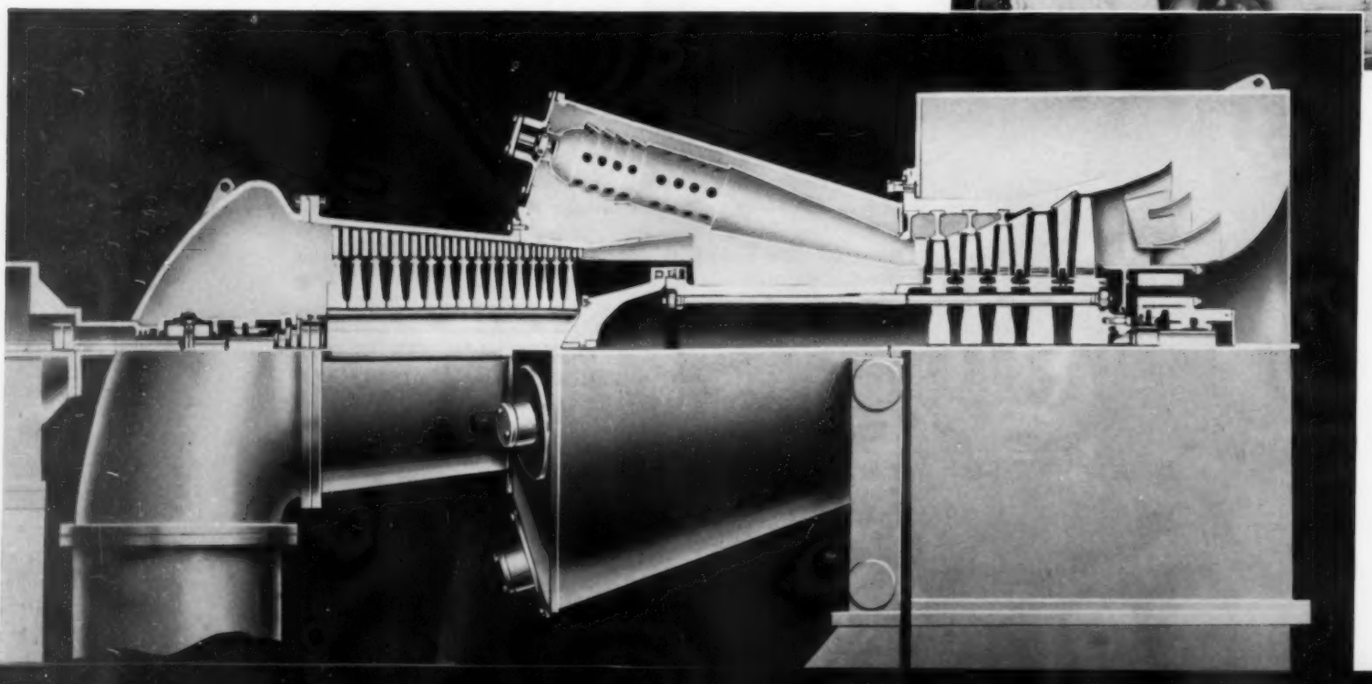


Figure 1—Cross-sectional view of an 8000 hp single-shaft gas turbine.



developed in the turbine element is approximately 1½ times the power required by the axial compressor. For a unit rated at 8000 hp output, the turbine element develops some 24,000 hp of which 16,000 hp is required by the axial-compressor element. The driven equipment, in this case a centrifugal-flow, gas-line compressor, is directly connected to the gas-turbine shaft at the compressor end of the unit. Because of this direct connection to the compressor-turbine shaft, the speed variation is dependent on the design of the gas turbine. At speeds lower than design, power output is limited either by the surge-line characteristics of the axial-flow compressor or by over-temperature of the gas turbine. Some further flexibility may be obtained by the use of an interstage bleed line on the gas-turbine compressor when compressor surge is the limiting item. This effectively increases the axial-compressor surge margin when at running speeds lower than design.

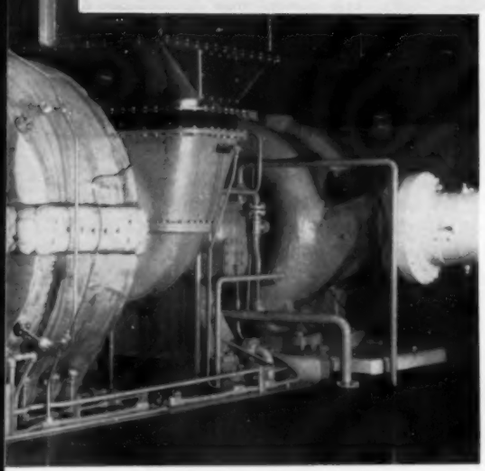


Figure 2—7500 hp regenerative-cycle single-shaft gas turbine in gas pipeline compressor application.

Fig. 2 shows the interior of a gas-line compressor station equipped with a 7500-hp regenerative-cycle, single-shaft gas turbine. Fig. 3 shows a cross-sectional view of a 5000-hp two-shaft gas turbine suitable for a direct connection of the power turbine shaft to a pipeline compressor. In the gas-generator portion of the machine, two axial-flow turbine stages are directly connected to the axial-flow compressor, and the single-stage power turbine is mechanically independent of the compressor-compressor turbine shaft. In a sense, the power turbine acts essentially as a hydraulic coupling between the power-producing elements and the driven load. Therefore, the output speed variation is dependent on the speed-power characteristics of the load. For two-shaft units in gas-line pumping applications, it is always the surge-line characteristics of the driven pipeline compressor which impose the lower limit of operation.

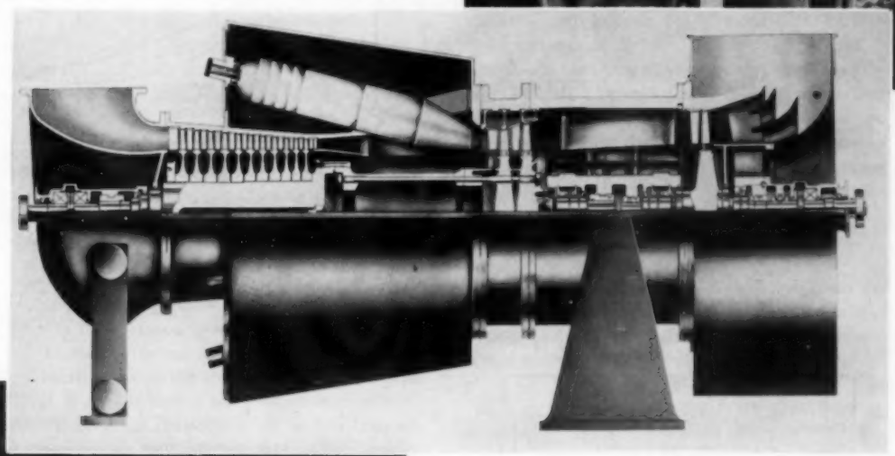


Figure 3—Cross section of a 5000 hp two-shaft gas turbine suited for direct connection to centrifugal compressor.

Fig. 4 shows the interior of a gas-line compressor station equipped with three 5000-hp, two-shaft regenerative-cycle gas turbines, two of which are visible in the illustration.

Horsepower - Speed Relationships

In any comparison study some limits must be set forth at the outset. The comparison of operating characteristics made here will be for units of equal power operating in a single-unit station with constant station-discharge pressure. Figure 5 presents the combined operating field of the gas turbine, centrifugal compressor, and pipeline, for operation at ambient temperatures of 40° and 80° F. The power output of a gas turbine operating at 40°F and below is approximately 125 per cent of rated power. To take advantage of the increased capability at low ambient temperatures, the gas turbine and centrifugal compressor must be matched in such a way that the added capability can be applied to the line without exceeding the maximum speed of the gas turbine. For constant station-discharge pressure, the additional low ambient output can be applied to the line only by increasing the speed of the centrifugal compressor, thereby increasing the flow. Therefore, the speed-horsepower relationships of the pipeline, gas turbine, and centrifugal compressor must be studied in line with the expected ambient temperature in order to match efficiently the gas turbine and centrifugal compressor to provide maximum operating flexibility. Single-shaft gas turbines can provide approximately plus or minus 8 per cent speed variation at full load. If the turbine and centrifugal compressor are matched at rated speed at rated load on an 80°F day, there will be sufficient speed margin so that 125 per cent of rated power can be applied to the line at ambient temperatures of 40°F and lower. The operating line shown in Fig. 5 with all stations operating, is shown matched at 100 per cent speed at 80°F, which provides a speed of 108 per cent at 125 per cent power at temperatures of 40°F and lower. Thus, at 125 per cent power output, maximum turbine speed has not been exceeded.

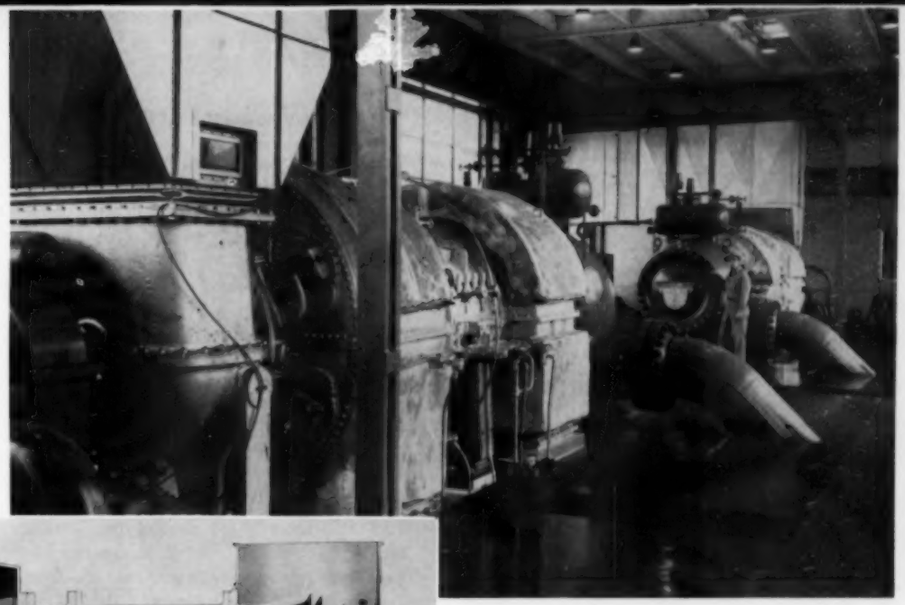


Figure 4—Gas pipeline compressor station showing two of three 5000 hp, two-shaft gas turbines.

For a properly matched single-shaft gas turbine-centrifugal compressor power plant, the lower limit of operation along the gas-compressor operating line for the turbine being studied is set by the surge-line characteristics of the compressor element of the gas turbine. Point A in Fig. 5 is the operating limit with the compressor interstage bleed open for an ambient temperature of 80°F. This limit occurs at 79 per cent of design speed and 54 per cent of rated power. Pipeline flow at this point is 82.5 per cent of design flow. For operation at 40°F ambient temperature, the gas-turbine operating field expands slightly as shown and the operating limit shifts to point B, which occurs at 71 per cent design speed and 38 per cent of

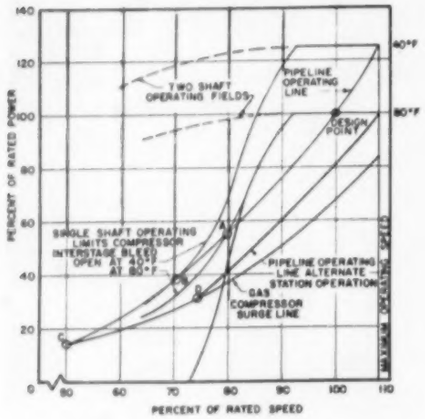

PERCENT OF RATED POWER
PERCENT OF RATED SPEED
TWO SHAFT OPERATING FIELDS
PIPELINE OPERATING LINE
DESIGN POINT
40°F
80°F
SINGLE SHAFT OPERATING LIMITS COMPRESSOR INTERSTAGE BLEED OPEN AT 40°F AT 80°F
PIPELINE OPERATING LINE ALTERNATE STATION OPERATION
GAS COMPRESSOR SURGE LINE
MAXIMUM OPERATING SPEED

Figure 5—Combined operating field for gas turbine, compressor and pipeline at constant station-discharge pressure.

rated power. The pipeline flow at this point is 74 per cent of design flow. Thus, on a 40°F day, pipeline flow variation from 74 to 104 per cent is possible with all stations operating and each station discharging at constant pressure.

For two-shaft operation, the lower limit of operation is set by the intersection of the operating line and the gas-compressor surge line. This limit is shown by point C in Fig. 5. It occurs at 50 per cent speed and 14 per cent rated power. Pipeline flow at this point is 44 per cent of design flow. Thus a two-shaft gas turbine provides a variation of pipeline flow from 44 to 100 per cent on an 80°F day and from 44 to 104 per cent on a 40°F day. There are various ways to increase the possible pipeline flow variations of single-shaft units to a point approximately equal to the variation possible with two-shaft units. The most efficient method of accomplishing this is by the use of inlet guide vanes on the centrifugal compressor which add additional flexibility as shown by Fig. 6. With some sacrifice in line packing but with a saving in operating labor, an effective way of obtaining increased flow variation at constant station discharge pressure is by alternate station operation. The gas-compressor operating line for alternate station operation is also shown in Fig. 5. The lower limit of pipeline flow with alternate stations operating is set by the intersection of the alternate station operating line and the gas-compressor surge line. This is shown by point D and occurs at 74 speed and 31 per cent rated power. Pipeline flow is 54 per cent design flow. Thus for a single-shaft unit flow variation is possible from 54 to 100 per cent on an 80°F day by a combination of speed variation and alternate station operation with still further flow reduction possible by the use of compressor-inlet guide vanes. The two-shaft gas turbine which is often thought of as having considerably greater flexibility than the single-shaft unit is in reality capable of handling only about 10 per cent greater pipeline-flow variation. It should be noted that this increased flexibility only occurs at the lower portion of the operating field; the lower limit of operation being set by the surge-line characteristics of the driven centrifugal compressor and not by the prime mover. Fig. 7 presents the variation of pipeline flow with speed along the two operating lines shown in Fig. 5.

Efficiency Variations At Part Load

When the efficiency of the unit is of prime importance, a regenerative-cycle gas turbine should be chosen, when it can be determined that the higher initial cost can be offset by savings realized by decreased fuel consumption. Fig. 8 shows the variation of specific fuel consumption as a function of per cent of rated power for four different configurations, all of which are regenerative. As shown, the part-load efficiency of the single-shaft regenerative gas turbine is exceeded only by a two-shaft gas turbine equipped with variable power-turbine diaphragms to provide constant turbine-exhaust temperature at part-load operation. However, if turbine-exhaust temperature at rated power is near the regenerator maximum temperature, then this latter method of operation is not possible since turbine-exhaust temperature and hence regenerator-inlet temperature would increase at part load if turbine-inlet temperature is held constant. Therefore, the single-shaft regenerative gas turbine will provide a higher part-load efficiency where the exhaust temperature is limiting; a fact that has not always been appreciated fully.

Conclusion

For the operator to evaluate whether a single-shaft or two-shaft unit is required, the load factor must be considered to determine the amount of operation

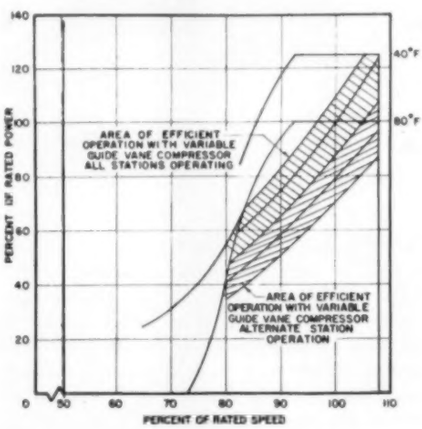

PERCENT OF RATED POWER
PERCENT OF RATED SPEED
40°F
80°F
AREA OF EFFICIENT OPERATION WITH VARIABLE GUIDE VANE COMPRESSOR ALL STATIONS OPERATING
AREA OF EFFICIENT OPERATION WITH VARIABLE GUIDE VANE COMPRESSOR ALTERNATE STATION OPERATION

Figure 6—Effect of variable guide vanes on horsepower-speed relationships.

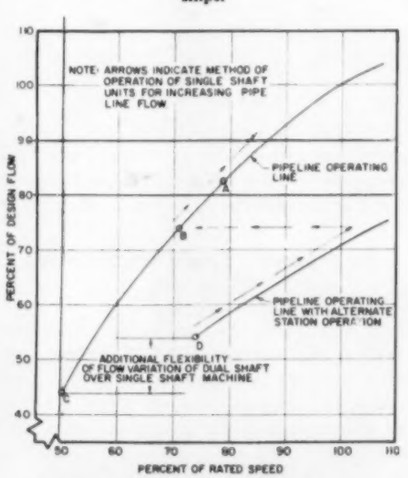

NOTE: ARROWS INDICATE METHOD OF OPERATION OF SINGLE SHAFT UNITS FOR INCREASING PIPE LINE FLOW
PERCENT OF DESIGN FLOW
PERCENT OF RATED SPEED
PIPELINE OPERATING LINE
PIPELINE OPERATING LINE WITH ALTERNATE STATION OPERATION
ADDITIONAL FLEXIBILITY OF FLOW VARIATION OF DUAL SHAFT OVER SINGLE SHAFT MACHINE

Figure 7—Variation of pipeline flow with compressor speed.

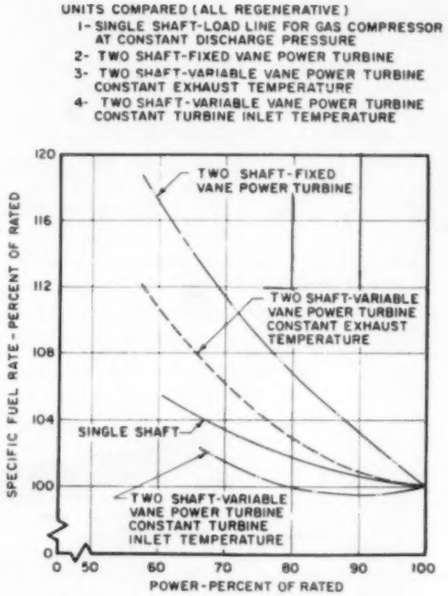

UNITS COMPARED (ALL REGENERATIVE)
1- SINGLE SHAFT-LOAD LINE FOR GAS COMPRESSOR AT CONSTANT DISCHARGE PRESSURE
2- TWO SHAFT-FIXED VANE POWER TURBINE
3- TWO SHAFT-VARIABLE VANE POWER TURBINE CONSTANT EXHAUST TEMPERATURE
4- TWO SHAFT-VARIABLE VANE POWER TURBINE CONSTANT TURBINE INLET TEMPERATURE
SPECIFIC FUEL RATE - PERCENT OF RATED
POWER-PERCENT OF RATED
TWO SHAFT-FIXED VANE POWER TURBINE
TWO SHAFT-VARIABLE VANE POWER TURBINE CONSTANT EXHAUST TEMPERATURE
SINGLE SHAFT
TWO SHAFT-VARIABLE VANE POWER TURBINE CONSTANT TURBINE INLET TEMPERATURE

Figure 8—Comparison of fuel rates of gas turbines driving pipeline compressors.

in the 44 to 54 per cent flow region where the single-shaft gas turbine would require recirculation. The greater fuel consumption of a single-shaft unit because of the recirculation during periods of low flow, i.e., usually weekends during summertime operation, must be weighed against the lower initial installed cost of the single-shaft machine. This is approximately $10 per installed horsepower at today's price levels.

For the final evaluation, the operating items given in Table I should be weighed.

There are applications for both types of gas turbines depending upon the gas-line load factor. For low load-factor lines the two shaft would generally be the choice and for high load-factor lines the single-shaft gas turbine is preferred because of its simplicity and good efficiency.

Table I Operating Considerations

	Two shaft	*Single Shaft*
Installed cost	+ $10/hp	
On-line control	Difficult to prevent overspeed of gas compressor during line upset	Good speed and line-upset control as gas compressor is connected to complete turbine
Maintenance Considerations	6 journal and 3 thrust bearings. Gas-compressor thrust bearings and seals are started under load	4 journal and 2 thrust bearings. Gas-compressor thrust bearings and seals are started at no load.
Starting and Loading	Operation is simple since centrifugal compressor is started while pressurized.	Operation is more complicated. Starting is accomplished with centrifugal compressor casing depressurized. Loading is accomplished by pressurizing the centrifugal compressor after the gas turbine is past self-sustaining speed

BATTERY DESIGNS FOR HEAVY-DUTY SERVICE

FURTHER developments in adapting electrical equipment more closely to the service conditions of diesel engines they serve are found in new diesel battery designs recently announced by The Electric Autolite Company. In their Anchor Bond batteries, Autolite engineers have found a new way of anchoring battery plates and separators to the battery container so these elements will resist vibration and shock loading to a much greater degree than previous designs.

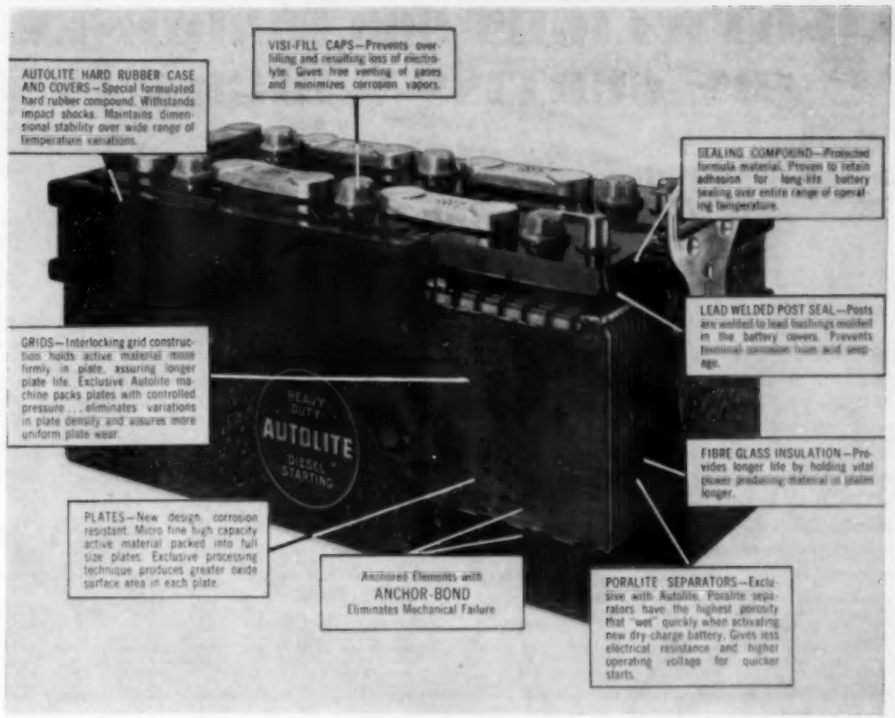
In research work, including use of a stroboscopic light to study movement of battery elements, Autolite engineers found that there was movement of the element and individual element components within their battery container when the battery is placed on a vibration machine. At times, plates and separators actually bounced on the container bottom, damaging those components.

This damage to elements and their plates and separators was the result of using a flexible sealing compound in original designs which yields to the stresses imposed by the weight of the element during vibration. Once loosening occured, this vibration of the element components was magnified and even more serious damage resulted with the plates and separators becoming notched from the bouncing on the bottom of the case. The Auto-Lite test work on their batteries showed further that separators fall out of alignment because of the vibration and permit shorting at the top of the plates. Active material is lost from the vibrating plates in the form of hard pellets that abrade the adjacent separators while being shaken to the bottom of the container. This abrading action results in holes in the separators that again permit shorting of the plates and failure of the battery.

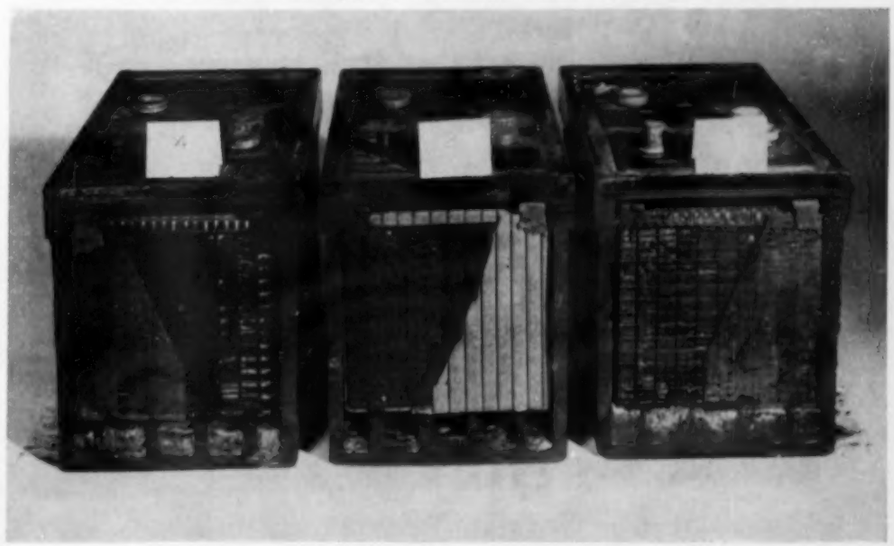
Since plate destroying vibration is usually very pronounced in heavy duty vehicular type diesel applications, it is one of the major causes of battery failures. Recent development of special thermosetting resins by Autolite enabled them to design a battery in which plates and separators are firmly anchored to the container. This material forms an integral bond between the plates, separators and container that eliminates the possibility of elements vibrating at frequencies different than that of the container. Thus, the entire battery functions as a strong, vibration-resistant unit.

Anchored construction also permits the use of the Poralite separator in all types of diesel batteries. This separator is noted for its good performance qualities and is made of a special resin-impregnated, ribbed paper material, similar in some respects to the highly porous paper elements used in lube and fuel oil filters. It is very porous and provides for excellent exchange between positive and negative plates. This type of separator, however, is not quite as physically strong as the rubber or wood types commonly used in heavy duty batteries. But with the anchoring process, they can be used in the most rugged application and won't be damaged by vibration and bouncing of the battery.

It is expected these new batteries will offer greatly increased life in diesel service and J. L. Rooney, chief engineer of the Autolite Battery Division commented on this as follows: "The Anchor Bond construction eliminates service-incurred mechanical damage as a cause of battery failure, and permits the battery to perform its electrical functions until the end of normal life. Because of this, Anchor Bond construction has already gained acceptance by several vehicle manufacturers after extensive testing in the laboratories and under severe field service conditions. Two manufacturers of crawler tractors have completed their own testing of these new diesel batteries and have certified them for original equipment use. More applications include highway diesel trucks, back roads service and in export passenger car and truck batteries where rough roads are the usual conditions. For all of these and other uses the Anchor Bond construction will be available in Autolite's entire line of heavy duty bus, truck and diesel batteries."

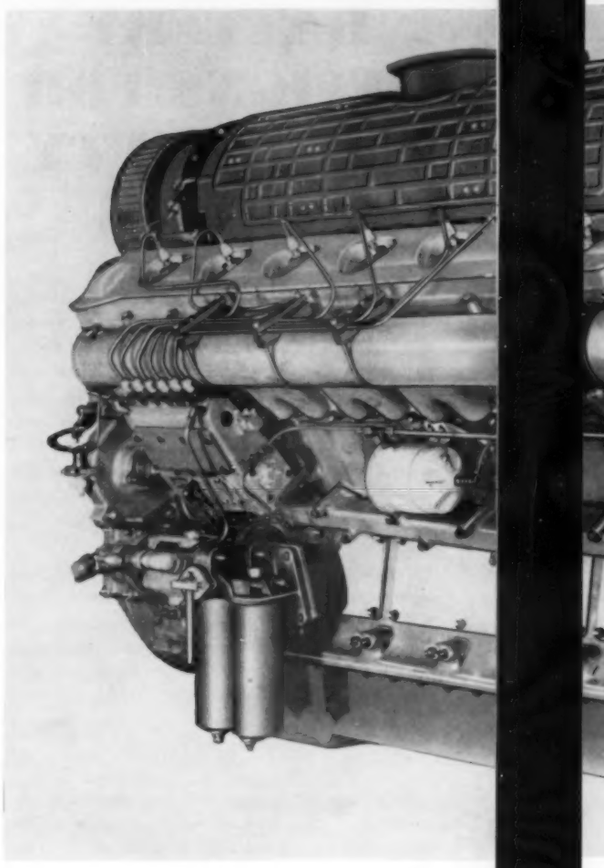

VISI-FILL CAPS—Prevents overfilling and resulting loss of electrolyte. Gives free venting of gases and minimizes corrosion vapors.
AUTOLITE HARD RUBBER CASE AND COVERS—Special formulated hard rubber compound. Withstands impact shocks. Maintains dimensional stability over wide range of temperature variations.
SEALING COMPOUND—Protected formula material. Proven to retain adhesion for long-life battery sealing over entire range of operating temperature.
LEAD WELDED POST SEAL—Posts are welded to lead bushings molded in the battery covers. Prevents terminal corrosion from acid seepage.
GRIDS—Interlocking grid construction holds active material more firmly in plate, assuring longer plate life. Exclusive Autolite machine packs plates with controlled pressure . . . eliminates variations in plate density and assures more uniform plate wear.
HEAVY DUTY
AUTOLITE
DIESEL STARTING
FIBRE GLASS INSULATION—Provides longer life by holding vital power producing material in plates longer.
PLATES—New design, corrosion resistant. Micro fine high capacity active material packed into full size plates. Exclusive processing technique produces greater oxide surface area in each plate.
Anchored Elements with
ANCHOR-BOND
Eliminates Mechanical Failure
PORALITE SEPARATORS—Exclusive with Autolite. Poralite separators have the highest porosity that "wet" quickly when activating new dry-charge battery. Gives less electrical resistance and higher operating voltage for quicker starts.

Cut-away view of three batteries after simultaneous field test on same OTR tractor reveals that the Anchor-Bond Battery (center) has suffered virtually no damage after treatment that has robbed two conventional Auto-Lite batteries (left and right) of power-producing material and created paths for short-circuiting of elements. Tractor was in service 13 months recording approx. 100,000 miles. This test was conducted by Auto-Lite in cooperation with Motor Truck Services, Inc. of Detroit, Mich.



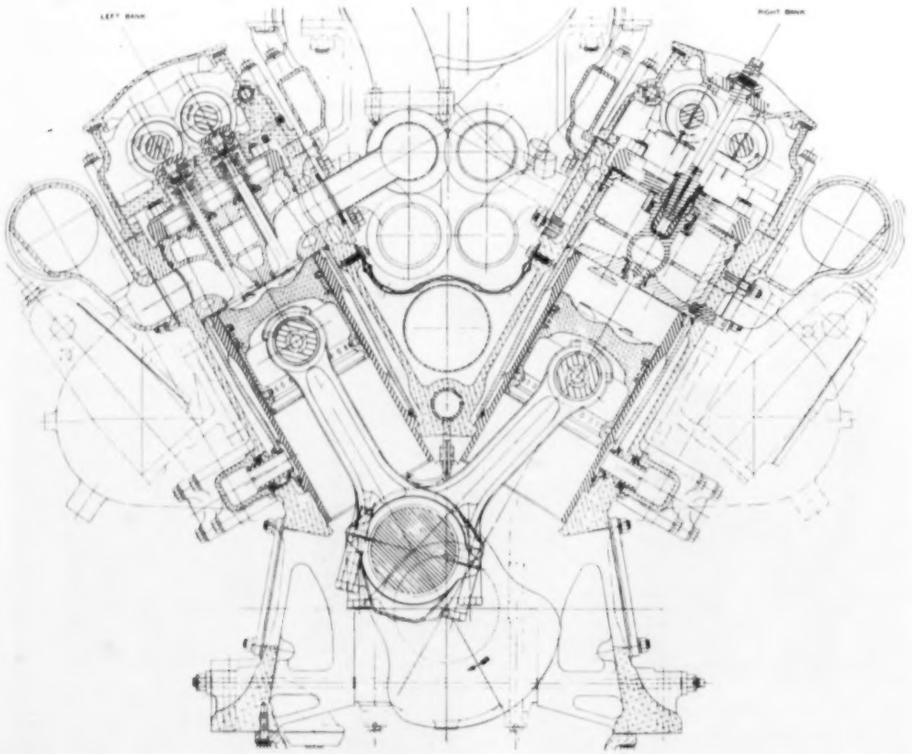
LIGHTWEIGHT 900 HP DIESEL BY CURTISS-WRIGHT

New 12-Cylinder Engine in Pre-Production Stage of Development: First Model Announced is A Turbocharged Marine Unit



UNDER the sponsorship of the U.S. Navy Bureau of Ships, Curtiss-Wright Corp., Utica Division has developed the first model of a new family of high speed diesel engines. The first unit is a light weight and compact 900 hp engine for marine applications. The design of the engine is adaptable for both military and commercial applications. Designated the 12V-142, the new engine is a turbocharged, liquid cooled, four cycle, 12 cylinder, 60 degree vee type design utilizing a prechamber combustion system. With a bore of 5⅜ in. and stroke of 6¼ in., the engine has a piston displacement of 1704 cu. in. and a compression ratio of 14.5:1. Using two exhaust gas driven turbochargers and Perfex raw-water cooled aftercoolers, the engine has a continuous rating of 900 bhp at 2300 rpm. This rating varies, depending on the amount of aftercooling. Considering its 1704 cu. in. displacement, the engine has a ratio of .53 hp/cu. in., while the overall package size of 72⅜ in. x 43 in. x 53⅜ in. gives a ratio of 9.6 hp/cu. ft. of package space. It has a low 4.5 lbs. weight to horsepower ratio, based on the 900 hp continuous rating and engine weight of 4050 lbs. with all attached accessories.

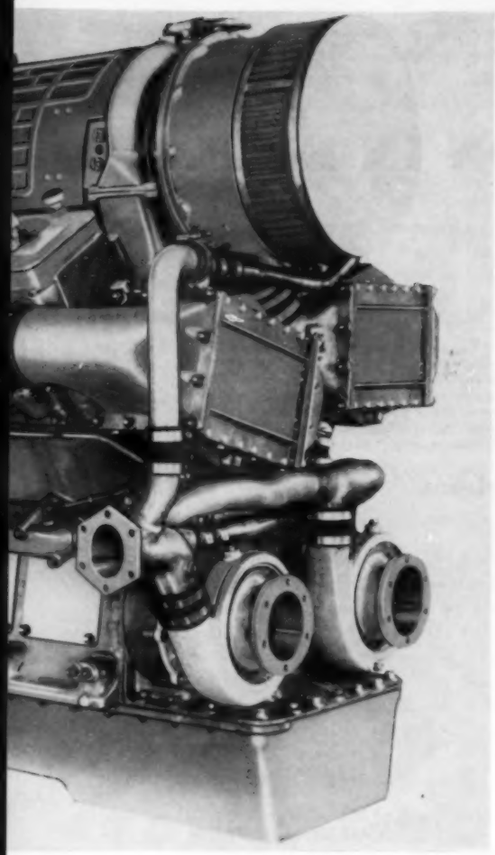
The 12V-142 is a straightforward engine in which Curtiss-Wright engineers have combined aluminum and steel components without resorting to special machining to achieve its low weight/hp ratio. Air manifold, camshaft cover, camshaft housing, cylinder block, flywheel housing, freshwater pump housing, oil pan, and air and water manifolds are all SAE 322-T-51 or SAE 322-T-71 aluminum casting. The unit cast aluminum block and crankshaft form the basic structure of the vee engine. Cylinder liners and head are seated in recesses in the cylinder block, with the engine combustion air and exhaust gases passing through cast passages in the block. Exhaust passages are water-jacketed. This construction permits bolting the air manifolds, exhaust manifolds, and water outlet headers directly to the engine block where they need not be removed when servicing any of the engine components or accessories. To help form a rigid structure, the crankshaft centerline in the block is located well above the mating surface between the block and oil pan. Forged aluminum main bearing caps are held in place by long vertical studs and clamped by lateral bolts to form a rigid box section.



A feature of the 12V-142 is the spherically shaped precombustion chamber centrally located in the cylinder head above the piston center, which opens into the main chamber through a unique multiple orifice called the "burner". Fuel is injected directly into the precombustion chamber. The prechamber permits high bmep without excessive peak pressures on the main power parts. The precombustion chamber is water cooled to protect the injection nozzle from high temperatures. The communicating "burner" is of a high heat resistant alloy that stores heat to aid fuel vaporization by heating the air as it is forced into the precombustion chamber. Controlled turbulence created by the multi-orifice "burner" and the dispersing cone on the piston head provides thorough mixing and clean burning of the fuel.

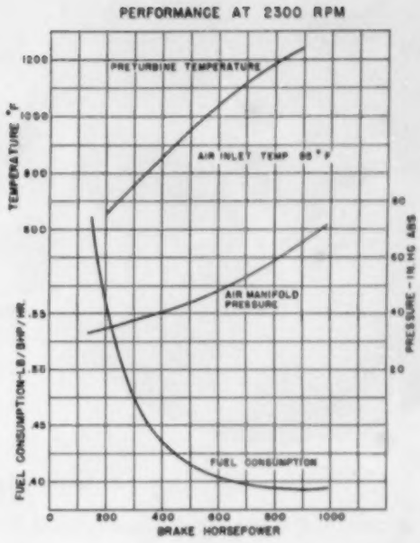
Each head also carries two intake and two exhaust valves. Valve seat inserts are of heat resistant alloy; guides are cast iron. Exhaust valves are sodium cooled. Wet type cylinder liners are of forged steel and nitrided to provide a hard wearing surface. Pressed-on water cooling jackets prevent the cooling water from contacting the aluminum crankcase. Internal ribs in the water jackets stiffen the liners and reduce the tendency for liner vibration and cavitation. Each individual head and liner combination is held in place by a forged steel plate on top of the head. The plate, in turn, is secured by four long (17 in.) steel studs extending

Transverse section, Curtiss-Wright 12V-142 diesel engine.



Curtiss-Wright 12V-142 engine, free end, marine version. Aftercoolers, fresh-water and raw-water pumps are at the free end. Exhaust and air manifolds need not be removed when servicing major power parts.

Power curve, 12V-142



down into the crankcase bearing webs, providing the elasticity needed in the retention system.

Two overhead camshafts are used in each cylinder bank. They are carried directly in the aluminum camshaft housing, without use of separate bearings and employ hydraulic tappets. The camshafts, housing, and tappets are removed as a single assembly to allow easy access to the cylinders and pistons. Pistons are cast aluminum and cam ground to more closely fit the cylinder barrel when both are hot and under load. Three compression and two oil rings are used.

Connecting rods are "I" section alloy steel forgings with strip type aluminum bearings on the big end, and bronze bushings on the piston pin end. The split line of the rod cap is at a 45 degree angle to permit removal of the piston and rod through the bore. The forged seven-bearing crankshaft has integral counterweights and the accessory gear drive is also forged integrally with the shaft at the drive end. Crank cheeks and counterweights are machined only as necessary for clearance, and the crankshaft is nitrided for high endurance limit and to provide hard, long life journal surfaces. Solid aluminum bearings, with high load capacity, good heat transfer, and a thermal expansion characteristic similar to that of the aluminum cylinder block, are used. A viscous-fluid torsional vibration damper is attached directly to the free end of the crankshaft.

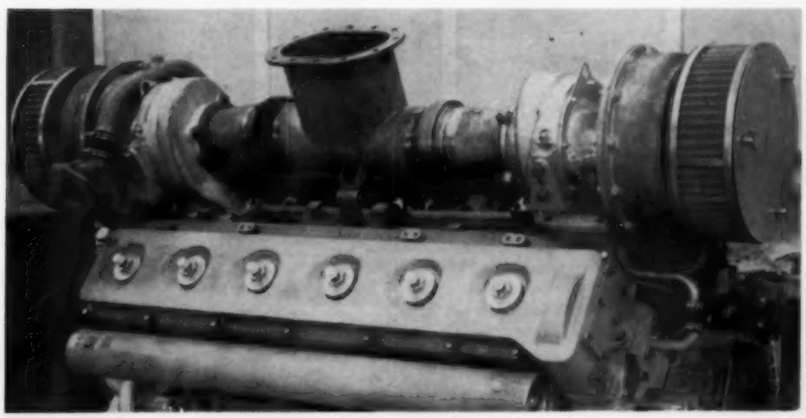
Good turbocharger turbine performance is obtained through the use of uncooled, fabricated stainless steel manifolds with bellows placed at strategic points to permit expansion. Heat shields are placed above and below the manifolds to control heat radiation.

Separately filtered oil from the engine pressure system is supplied to each turbocharger for lubrication and cooling. Exhaust gases from the turbochargers are joined through a duct over the exhaust manifolds and discharge from a common opening. The duct is placed under the upper exhaust manifold heat shield and is rigidly mounted on the block and attached to the turbochargers through flexible bellows connections.

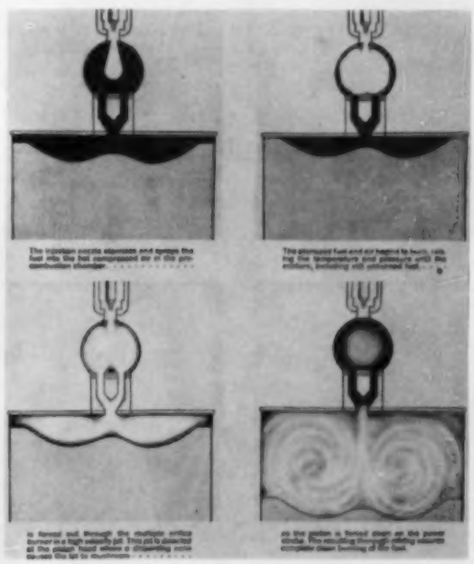
Fuel injection is accomplished with two multiplunger American Bosch APE-BB injection pumps; one for each bank. The pumps are mounted outboard under the intake manifold. A separately driven gear type fuel supply pump supplies both injection pumps. Injectors are of the outward opening pintle type, which do not require fuel return tubes and are individually removable without disturbing camshaft housing or covers. An isochronous governor at the drive end of the engine is connected to the fuel pumps through mechanical linkage. The control system, working with the governor and air or electric starting motor, is designed to start, regulate, and stop the engine through a single control lever. A hydraulic overspeed shutdown device is included in the linkage system to shut off fuel flow if engine overspeeding should happen to occur.

Summing up, the Curtiss-Wright 12V-142 is a high horsepower unit, with major design aims of durability at high power ratings, a small compact lightweight package, and ready accessibility for service.

Exhaust manifolding on the 12V-142. The two turbines exhaust into a common outlet which is rigidly connected to the block through support brackets and connected to the turbochargers by flexible bellows extensions.



Combustion chamber design of the 12V-142 utilizes a spherically shaped precombustion chamber located above piston center and opening into main chamber through unique multiple orifice called the "burner."



WHAT'S GOING ON IN ENGLAND

CONDUCTED BY **BERNARD W. LANSDOWNE**

Bernard W. Lansdowne is an associate member of the Institution of Mechanical Engineers and is widely known among British and European diesel manufacturers as a former editor of our English contemporary "Gas & Oil Power." His early workshop training was spread over seven years with A.E.C. Ltd., Southall, following which he served some five years with that company's sales engineering department. He is now manager-for-the-United Kingdom of a group of business and technical publications.

New Devices to Smooth Fuel-Supply Problems

A NUMBER of pieces of equipment designed to improve the lot of diesel engine operators have come on the market in the United Kingdom in recent months and should find appeal among users all over the world. Included among them are an automatic bulk loading fuel control valve of particular interest to diesel locomotive operators, and a fuel viscosity controller of value not only to diesel engine users but also to a multitude of other industries where frequent checks on a liquid viscosity is necessary.

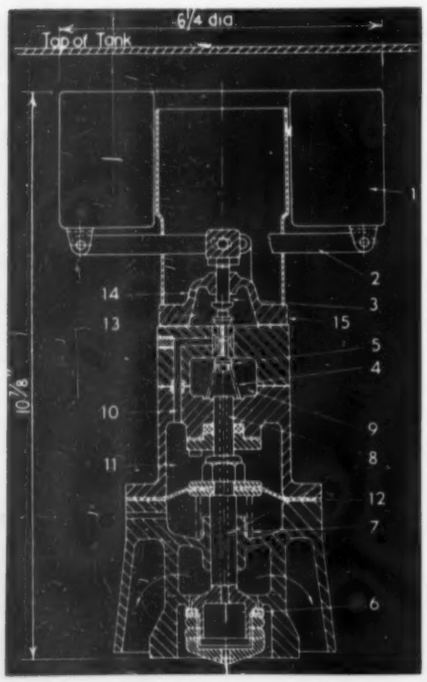
Load Control Valve

Dealing first with the bulk load control valve, this is an automatic device marketed by Zwicky Ltd. of Slough, Buckinghamshire, which is attracting attention in the United Kingdom arising from the great increase in the use of diesel locomotives throughout the British railway network and in industrial railway sidings. In the past, so far as England is concerned, loading of a diesel locomotive fuel tank has been left largely to the operator who was required to watch a number of gauges simultaneously. This led to considerable wastage from over-filling and gave rise to a serious fire risk. Development of the Zwicky "Full-Stop" loading valve, as it is called, is claimed to eliminate these problems and at the same time facilitate quicker turn round of locomotives in operation, particularly as it enables one operator to fuel a number of locomotives simultaneously without the necessity for constant watch on each content gauge.

The valve is mounted on a flange at the top of a vertical pipe within the fuel tank, the flange being approximately 11½ in. from the top of the tank, allowing fuel to rise to a level 1 in. below the tank top. The lower end of the vertical pipe passes through the bottom of the tank and is teed into a fueling gallery which is common to all tanks and which is fitted with a self-sealing coupling.

The operating principle is as follows: With the tank empty the float (1) will be in the lower position approximately ½ in. below the full height of the float. The float, in the lower position, will overcome the pilot valve spring (4) and move the pilot valve assembly (5) to open the lower valve and close the upper. Float movement is transferred through linkage (2) and plunger (3). The fueling coupling is then connected and fuel fed through the gallery to the main valve (6) which is held closed by the main spring (7). Pressure sensed on the main valve is bled through the drilling (8) in the valve spindle to the lower pilot valve chamber (9), through the open pilot valve into the body drilling (10) and thence to the diaphragm chamber (11). A pressure of 4 psi on the diaphragm (12) will overcome the main valve spring and open the main valve.

As the tank is filled the fuel lifts the float, allowing the pilot valve spring to reassert itself, closing the lower pilot valve and opening the upper. This shuts off line pressure from the fuel gallery to the diaphragm and relieves the pressure on the diaphragm through the body drilling and the pilot valve into the upper pilot valve chamber (13) to tank atmosphere through the drilling (14) in the pilot valve cover (15). With the pressure relieved from the diaphragm, the main spring reasserts itself, closing the main valve and shutting off fuel to that tank. The overall size of the valve is 6¼ in. diameter, its height is 10⅞ in.



Zwicky bulk load control valve.

Operation of bulk load control valve is explained in accompanying text.

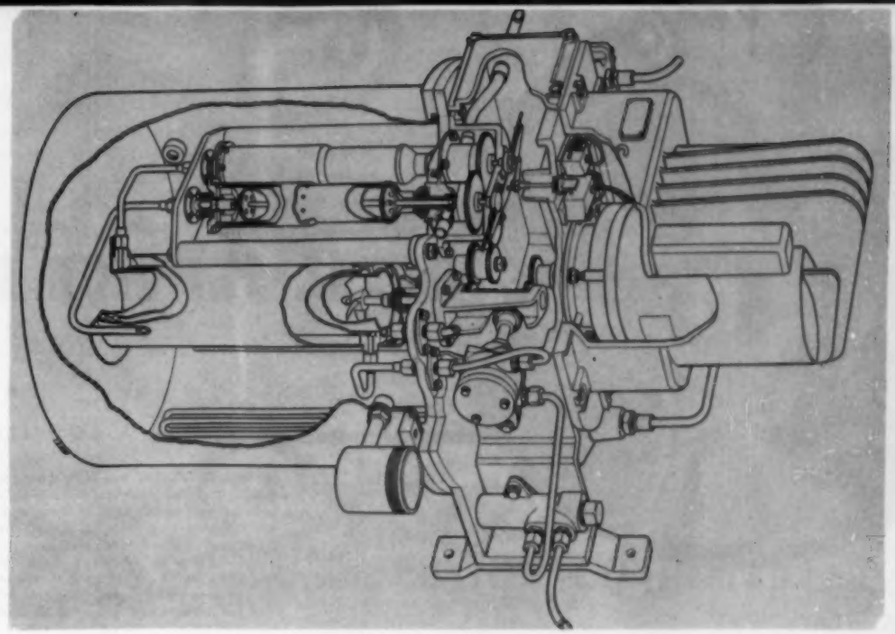
Viscosity Controller

THE new British fuel oil viscosity controller is a product of the Industrial Instruments Division of The Smiths Organization at Cricklewood, London. There are of course many ways of measuring viscosity, but methods of controlling it during a continuous process have always proved

difficult to employ. Temperature changes are the primary cause of trouble, a change as little as one degree F. resulting in errors as great as 5 percent in the final measurement. Close tolerances in viscosity readings are possible under laboratory conditions but the expense involved in this are too costly to be accepted by industry in general.

The Smiths viscosity controller was developed initially to meet requirements of the petroleum industry for an apparatus that would maintain viscosity of various grades of fuel oil within very close limits. The new controller now available provides continuous control of the blending process with such precision that it is now claimed to be possible, by using the instrument, to guarantee a products viscosity to within one percent. It is also claimed that use of the controller can save three to four percent per ton on the cost of making a fuel blend.

In operation the equipment uses two viscometers in which the viscosity of a sample from a pump line is continually balanced against the viscosities of a sample prepared in the laboratory. The viscosity of each sample is measured by a rotating cup viscometer, the output torque of which acts upon a balance arm. These viscometers both run in a water bath and are driven at the same speed by an electric motor. The laboratory-tested sample in its viscometer is at the temperature of the bath and the sample from the line supply quickly attains that temperature as it passes through the heat exchanger, which is also immersed in the bath. The precise heat of the bath is not important as the viscosity of each sample is measured at the same temperature. In practice, however, the temperature is increased when dealing with products of high viscosity in order to reduce the torque to a reasonable value.

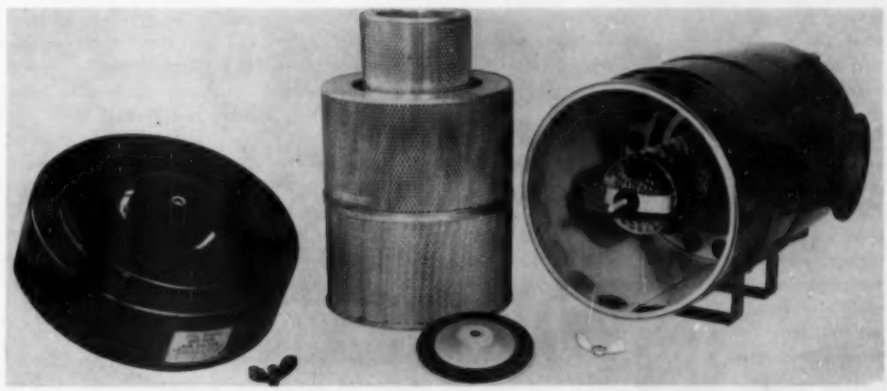


Cutaway drawing of Smiths viscosity controller.

It will be seen therefore that with identical viscometers running at the same speed and temperature, the torques will be equal if the viscosity of the standard sample is the same as the viscosity of the product under test. The balance arms therefore will be in a state of equilibrium. It follows from this that a change in viscosity of the line product will cause the balance arm to move and in so doing operate a micro switch or a pneumatic control.

Smiths state that commercial manufacturing tolerances make it impossible for two viscometers to have exactly the same gaps between moving and static elements in practice and accordingly an adjustment is provided for the fulcrum of the balance arm. Identical samples are run through the viscometers while adjustment is then made to achieve the required balance.

DRY AIR FILTER HAS TELESCOPING ELEMENTS



A NEW series of two-stage, dry-type air filters that have two filter elements in a single housing with each element independently sealed has been introduced by Purolator Products, Inc. for both heavy duty automotive and industrial engines. Available for both vertical and horizontal mounting, these new filters combine extra large working capacity with the important safety factor wherein one filter provides positive protection in the event the other is damaged.

The new two-stage, dry-type air filters were specifically designed to meet the demand for more efficient engine protection where automotive and industrial type equipment is continually operated under abnormally dusty conditions, such as construction, mining, logging, sand, cement, or gravel hauling. Both the first and second stage elements of the new two-stage filter operate independently at 99.8 per cent efficiency at all engine speeds. The second stage element's function is to provide continued engine protection in case the first stage, or working element, is damaged. According to Purolator engineers if the first stage element and sealing gaskets operate at maximum efficiency before requiring service or replacement, the second stage element will last indefinitely.

The elements are made from a plastic impregnated cellulose with a new depth type radial pleating for greater dirt holding capacity. The porosity of the filter media for both elements is the "extra fine" type. They are rated from 450 to 1150 cfm with an exceptionally low initial restriction. Extensive field testing has proven that the advantage of having a low initial restriction will provide element life anywhere from 600 to 2000 hours continuous use.

Mounting straps, rainhoods, and outlet adapters have been designed and are available for installing the new two-stage air filters in the field. Servicing the two-stage air filter does not require any special service program. The two-stage air filter is actually two elements, telescoped one into the other and independently sealed in one housing permitting the first stage element to be removed, cleaned or replaced without disturbing the second stage element. The second stage element provides additional protection during the time the first stage element has been removed for servicing or replacement, since the second stage continues to seal off the engine's air intake.

DIESEL SERVICE PROGRESS

A COMMENTARY BY **GEORGE R. MACKEY**

George R. Mackey was long associated with Detroit Diesel Engine Division of General Motors Corp., and had prior experience as a mechanic in Europe and the U.S.A., which enabled him to become well acquainted in the diesel and service fields and to obtain a broad scope of the service industry from the customer's and management's viewpoint. Further training at Carnegie Tech and in the Army Ordnance during World War II provided the necessary requirements in planning service programs. Progressive advancement in diesel service areas in General Motors and with Detroit Diesel led to his position as Supervisor of Service Promotion. Upon termination of employment with General Motors in 1952, he joined Clayton Manufacturing Company, and his present position with this organization is Sales Manager of the Dynamometer Division.

Engine Performance And Measurements

PEOPLE who are active in the diesel sales and service industries are often exposed to terminology which is applied to engine measurement and performance characteristics. While most of the common terms are generally applied by those having a common understanding of the diesel principles, there are a few which are more or less reserved to those responsible for engine design and development. To guide those interested in the service industry, an understanding of some of the terminology generally applied will be very helpful.

Work—Work may be defined as the result of force in action for a given distance. For example, when a force is applied to the movement of a truck which causes it to travel a given distance, measurable work is performed. Therefore, force times distance, equals work.

Power—Power is a measurement of work performed, or the rate at which work is done. For practical illustration, a machine which performs a considerable amount of work in a relatively short period of time can be looked upon as a high-powered unit. A machine which takes a much longer period of time to perform a comparatively small amount of work can be classified as a low-powered unit. Power, then, is the speed at which work is performed.

Horsepower—Horsepower is a continuation of the term power. It includes definite values from which power can be accurately measured. One horsepower is defined as performing work at the rate of 33,000 ft. lbs. per minute. This amount was first established from the findings that the average horse could lift 330 lbs. vertically at the rate of 100 ft. per minute, 330 x 100 = 33,000 ft. lbs. per minute, or one horsepower. This evalulation is often applied as 550 ft. lbs. per second, or 1,980,000 ft. lbs. per hour. Horsepower Hour is the work done at the rate of one horsepower per hour.

Indicated Horsepower—Indicated horsepower is the total power developed in the cylinders of an engine during the complete combustion cycle. This total developed power includes the horsepower usefully employed, plus the power consumed within the engine itself to overcome friction. For this measurement, a special indicating device is employed to complete a graph. From this graph, the (mep) mean effective pressure can be determined. The mean effective pressure is the average pressure developed during combustion and the power stroke of a cycle, minus the average pressures developed during the other strokes of the cycle. It is the pressure which, in effect, forces the piston down during the power stroke. With the mep and other known engine data, a formula is applied to compute the indicated horsepower, (ihp),

$$ihp = \frac{PLANK}{33{,}000}$$

where, P = the mean effective pressure (in psi); L = length of piston stroke (in feet); A = area of cylinder (in sq. in.); N = number of power strokes per minute (or rpm/2 for four cycle engines), and K = number of cylinders.

Many engine manufacturers include information on their sales data sheets from which the brake mean effective pressure can be determined. Such as, the brake mean effective pressure (bmep) for a given load and speed can be computed for four cycle engines by applying the following formula:

$$BMEP = \frac{792.000 \times \text{bhp load}}{\text{cu. in. displacement} \times \text{rpm}}$$

A manufacturer of two cycle diesel engines includes information on the engine data sheet from which the bmep can be determined by applying the following formula:

$$BMEP = \frac{\text{hp per cylinder} \times 5600}{\text{rpm}}$$

A portion of the power developed in an engine cylinder is used to overcome inherent engine friction. Thus, the indicated horsepower is always greater than the brake horsepower (bhp) or usable power developed.

Frictional Horsepower—Frictional horsepower is a term applied to express the amount of power actually required to overcome the friction within the engine. It is determined by driving an engine with a source of power which can be measured. Therefore, the measured power required to drive the engine through specified speed ranges is termed frictional horsepower. *Note:* While diagrams used to compute indicated horsepower are excellent for engineering research and study of combustion, and frictional horsepower is important in the study and development of engine design, neither are important to the engine user or servicing organization. In these fields, the main interest and concern is in the actual usable horsepower delivered at the engine shaft; that is, the indicated horsepower less the frictional horsepower, termed as the net or brake horsepower. This can be measured on any standard absorption type dynamometer, having the ability to absorb infinitely variable loads throughout a required speed range, and interpret the results accurately.

Brake Horsepower—Brake horsepower is the usable power actually developed. The term "brake horsepower" comes from the fact that a simple prony brake was widely used in the early days to measure power output. Today, even though dynamometers with more reliable absorption characteristics and accurate instrumentation are used in research, production and service, the term "brake horsepower" is still widely used. Some engine manufacturers have recently elected to use "dynamometer horsepower" instead of "brake horsepower".

Brake horsepower can easily be determined by applying the formula

$$HP = \frac{\text{Torque} \times \text{Speed}}{\text{Constant}}$$

or

$$HP = \frac{\text{Torque} \times \text{rpm}}{5250}$$

Maximum Rated Horsepower—Maximum rated horsepower is often referred to as intermittent horsepower and is the maximum output in terms of brake horsepower which the engine can develop with all operating conditions favorable. It is generally stated as being usable only under intermittent service for very short periods.

Rated Horsepower—Rated horsepower is the power which can be developed and for which most engines are rated in terms of brake horsepower.

Continuous Horsepower—Continuous horsepower is the maximum recommended load in terms of

brake horsepower for continuous day after day operation.

Peak Horsepower—Peak horsepower is based on specific tests to determine the maximum possible horsepower developed in an engine. These tests are made with a "stripped" engine and does not necessarily represent the usable horsepower available at the flywheel.

Mechanical Efficiency—Mechanical efficiency is the relationship between indicated horsepower and the actual usable horsepower developed. For average engines, the mechanical efficiency will range from 70 to 85 percent of the indicated horsepower, which means that, on an average, from 15 to 30 percent of the power developed in an engine is used to overcome internal friction.

Thermal Efficiency—Thermal efficiency is the relationship between the engine power output and the total energy in the fuel burned to produce this power. For an engine classified as having 35 percent thermal efficiency, it would indicate that 35 percent of the heat energy (Btu's) of fuel burned during the combustion process results in measurable brake horsepower. The remaining 65 percent of fuel heat energy is transferred to the engine cooling system, lost in the exhaust system, and used to overcome internal friction.

Last Chance Repowered

The 30 ft. snapper fishing vessel *Last Chance* of Maderia Beach, Fla. and owned by I. Hilton of Harvey's Seafoods, was recently repowered with a pair of model X heavy duty four cylinder Ford diesel engines converted to marine use by Modern Diesel Power Co. of Tampa. These four cylinder, four cycle heavy duty diesel engines have a bore and stroke of 3.94 in. x 4.52 in. and a displacement of 220 cu. in. They use Simms fuel injection systems. The new conversion installation included a Paragon 2:1 r&r gear and 20 in. x 20 in. propellers.

First and Largest In Florida

Florida Georgia Tractor Co., in Miami, delivered the first model 120 Hough front end loader, for use in Florida, to the Hollywood Quarries located west of Fort Lauderdale on Route No. 84. A four yard bucket is currently being used but the carrying capacity is 12,000 lbs. Power is with a model NRT6BI turbocharged Cummins diesel engine and Allison 3.5:1 single stage two phase torque converter. The Cummins diesel has a bore and stroke of 5⅛ x 6 in., a piston displacement of 743 cu. in. and develops 300 hp at a governed engine rpm of 2100. Loading cycle for a 12 yard truck takes 1½ min. The firm deals in aggregates and sand for building purposes.

READW NOW! The completely new 1960 edition of the **DIESEL AND GAS ENGINE CATALOG,** Volume 25, can now be purchased. If you design, purchase, sell, operate or service diesel, dual fuel, or gas engines, the Catalog is essential to you and your business. This giant, 442 page, 10½ x 13½", fully illustrated reference book has been rewritten, revised and brought up to date completely from cover to cover. Send your order in now for this limited edition, which costs just $10 postpaid anywhere in the world. Send checks, money orders or company orders to **DIESEL AND GAS ENGINE CATALOG,** 9110 Sunset Blvd., Los Angeles 46, Calif.

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AP935

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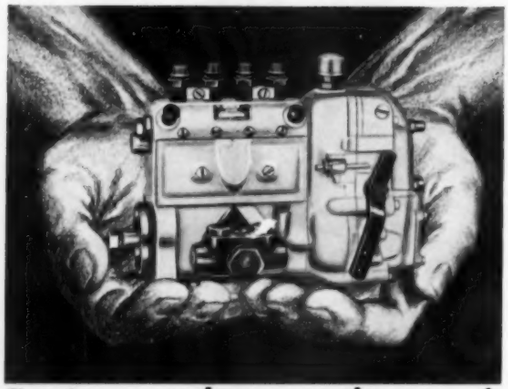
POW IN POWER



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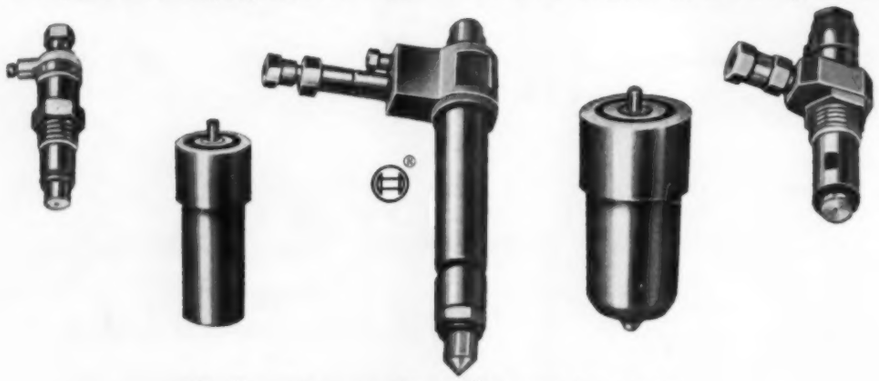

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The most highly regarded name in fuel injection equipment—that's ROBERT BOSCH and here's why: Experience dating back more than 30 years in equipment made to the closest tolerances...perfect performance on millions of engines...quality service the world over... most complete line of nozzles.

ROBERT BOSCH is the fuel injection equipment that made the high speed diesel engine practicable. It is used as *original* equipment by the world's most exacting engine makers, both here and abroad.

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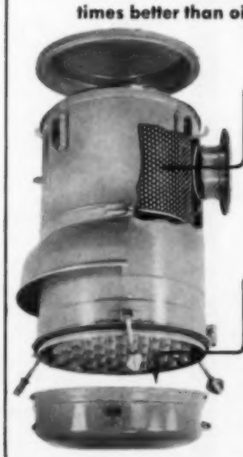
Don't try this with an ordinary paper filter!

Most paper filters can't stand moisture or humidity...
but you can wash the Duralife filter and save money!

Donaclones clean air 10 to 20 times better than oil bath types!



Only 2% of dust reaches Duralife paper filter!

Embossing and pleating provide maximum filtration area. Controlled porosity gives 99.9% dust removal.

98% of dust removed here!

Cluster of Donaclone tubes make up highly-efficient primary centrifugal cleaning stage. Dust is ejected into dust cup for easy servicing.

Washability proves 2 points

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2. Donaclones cost less to service. Filter seldom needs any attention because 98% of the dust is removed by the primary centrifugal cleaners. When it does need cleaning, you just dunk it in water and detergent . . . and it's like new. Replacements are mighty infrequent.

Leading equipment builders have switched to Donaclones because they protect their engines better. Install Donaclones on your equipment and get years of extra engine life. There's a dealer near you. Send coupon.

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Compressor Valves Brochure

A brochure on valves for compressors handling air, gases and other media and vacuum pump applications is available from the J.H.H. Voss Co. The brochure lists design and manufacturing features of Voss' line and shows how valves for different types of applications are constructed. Included also is a list of sales agents throughout the U.S. A copy of the booklet can be obtained by writing to the J.H.H. Voss Co., 785 E. 144th St., New York 54, N.Y.

New Lube Oil

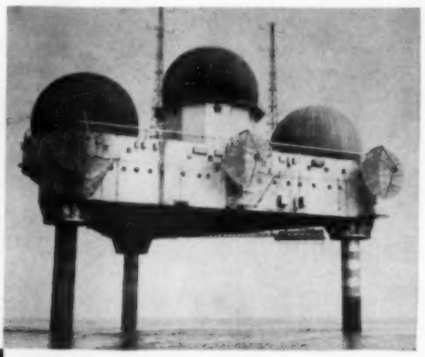
A new lubricating oil, Super RPM DELO Special, developed especially to upgrade the performance of diesel and heavy duty gasoline engines, has been introduced by Standard Oil Co. of California. According to SOCAL, this new lube oil assures equipment operators longer, more trouble-free engine life, with greater bearing protection, cleaner pistons, rings and valves. It is fortified to a new level with special detergent-action additives, corrosion and oxidation inhibitors and effective defoaming agent. Super RPM DELO Special has been thoroughly tested in the laboratory and under severe field conditions. Because of its wide work range (difficult-to-severe service), it has proven particularly effective for simplifying mixed fleet operations. It is especially designed, too, to control the bad effects of high sulfur diesel fuel. In performance, it exceeds the requirements of API Serivce Classification DG and DM. Super RPM DELO Special is now available through any Standard of California office or plant in the nine western states or through the following SOCAL subsidiaries: The California Co., Denver, Col.; The California Oil Co., Perth Amboy, N. J.; Standard Oil Co. of Texas, El Paso, Tex.; and Standard Oil Co. of British Columbia Ltd., Vancouver, B.C., Can. (ITS NEW)

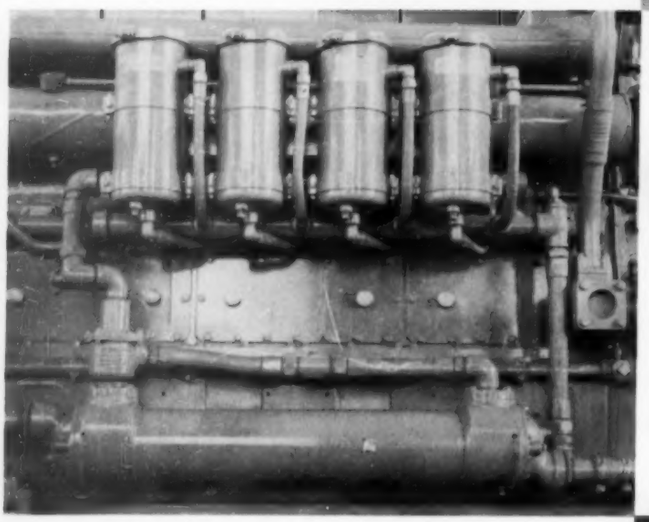
CIMAC Congress

The U. S. National Committee of CIMAC recently announced that the next Congress will be held at Copenhagen, Denmark, in June 1962. The theme of the Congress will be: *Recent Developments With Diesel Engines And Gas Turbines above 3000 hp And With Gas Engines Above 1500 hp.* The U. S. National Committee is sponsored by the Oil and Gas Power Division and the Gas Turbine Power Division of the American Society of Mechanical Engineers. John C. Gibb, chairman of the Oil and Gas Power Division is chairman of the U.S. National Committee. The vice chairman is R. Tom Sawyer, Treasurer of the Gas Turbine Power Division. Persons interested in presenting a paper at this meeting should send a resumé to the U. S. National Committee before December 15, 1960. The resumé, not exceeding two typed pages, must include a list of probable figures, graphs, and tables. The official languages for the Congress are English and French. The last CIMAC meeting was held in Wiesbaden, Germany, in June 1959 and was attended by 1000 men and women from 27 countries including 42 from the United States. For information on the preparation of papers for the meeting, or if you would like to be placed on the mailing list for future announcements, contact: Robert L. Stanley, Secretary of the U. S. National Committee, 2000 K Street, NW, Washington 6, D.C.

WINSLOW

CP* full-flow oil filters





...protect WHITE diesel engines in the north Atlantic!

Can you imagine a more rugged test of engine durability—or filter protection? White diesels—each with four Winslow CP* full-flow filters—generate the power used for these huge "Texas Tower" radar stations. Radar, lighting, ventilating, radio all depend on the Whites. And the Whites depend on Winslow for round-the-clock filter protection!

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Two materials—Fine and Super-fine—in each Winslow CP* element continuously self-adjust pressure, give TRUE full-flow of filtered oil, without incurring excessive back pressures.

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Jet-Driven Gas Turbine Described In New Cooper-Bessemer Brochure

A new eight page brochure, describing the concept and operating characteristics of the company's 10,500 hp, RT-248 Gas Turbine, has been published by The Cooper-Bessemer Corp. This is the first literature published by the firm on this unit, the gas generator section of which is built by Pratt & Whitney Aircraft, based on the J-57 jet engine. The publication reviews development of this new power concept, and discusses thermal efficiencies, maintenance costs, and potential applications. There are three pages of schematic drawings, performance curves and engineering data. First installation of the jet-driven gas turbine is expected to be made at Clementsville, Ken. pipeline station of Columbia Gulf Transmission Co. this fall. Copies of the brochure, No. 95, may be obtained from The Cooper-Bessemer Corp., Mount Vernon, Ohio. (ITS NEW)

New Turbine-Generator

A breakthrough in small gas turbine generated electrical power has been announced by The Garrett Corp.'s AiResearch Manufacturing division, Phoenix, Arizona. The new development is being demonstrated during a nationwide tour which started May 1. Utilizing newly developed silicon-controlled rectifiers, AiResearch has built a turbine powered unit which generates 3200 cycle electricity. This high frequency output is then statically converted to either 60 or 400 cycles. The new development frees the small gas turbine from restrictions imposed by the necessity of gearing high turbine rpm down to low reciprocating engine speeds for which existing generators were designed. The touring AiResearch demonstrator uses a 30 hp AiResearch small gas turbine driving a directly mounted generator. The unit produces 7½ kw. The tour unit precedes introduction of an AiResearch 60 cycle, 100 kw turbine driven generator set now under development. This unit, driving a high speed, shaft-powered generator directly mounted on the turbine, will weigh only approximately 800 lbs. as a complete set.

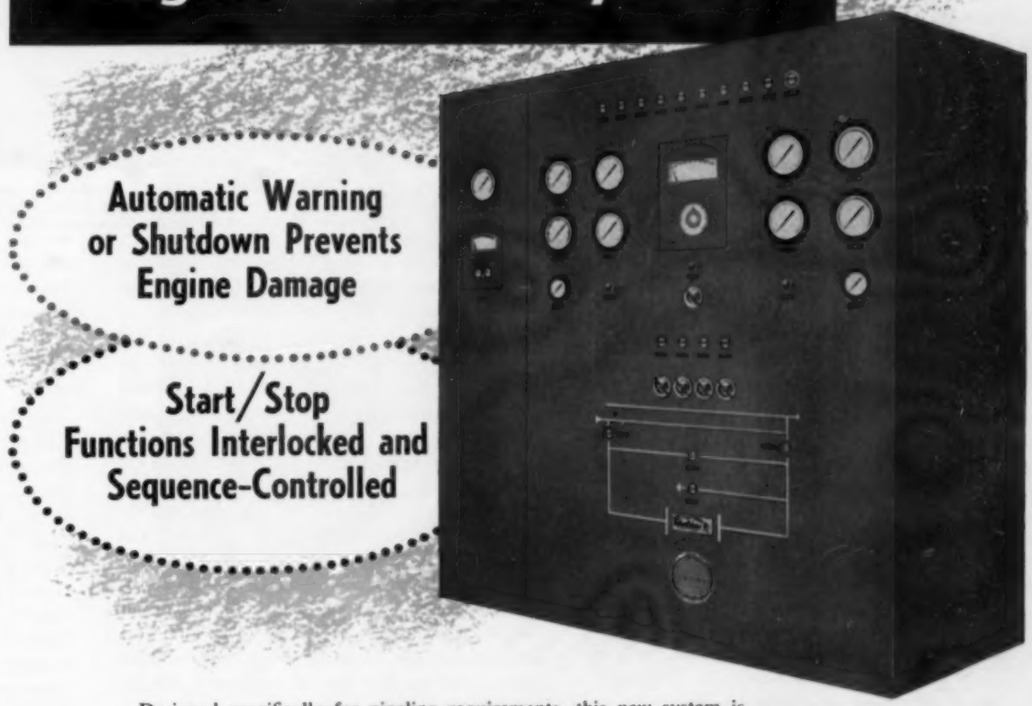
Transducers Brochure

A new, illustrated brochure just published by Kistler Instrument Corp., shows a full line of natural quartz crystal transducers for pressure, force, acceleration and vibration measurements. In addition to describing the range, sensitivity, and construction of transducers, the brochure highlights their characteristics for precisely measuring numerous physical phenomena. Sixteen pickup adaptors are also shown with descriptive text to point out applications and features. Final section describes and illustrates associated electronic equipment including Kistler Piezo-calibrators, amplifier-calibrators, low-noise cables, manual selector switch, and complete indicator or transducer systems. Copies of Bulletin 101160 may be obtained by writing to Kistler Instrument Corp., 15 Webster Street, North Tonawanda, N. Y. (ITS NEW)

Dekiep Named ASA Chairman

James DeKiep, engineering vice-president of Electric Machinery Mfg. Company, Minneapolis, Minn. has been appointed chairman of the American Standards Association, C-50, Committee. This committee has the responsibility of standards for all rotating electric machines built in the U.S. with the exception of those on transportation vehicles and aircraft. The committee membership is made up of a cross section of American manufacturers and users of rotating electric equipment. Chairman DeKiep will also be the technical advisor on rotating machinery of the International Electrotechnical Commission. The I.E.C. will meet in November, 1960, in New Delhi, India.

Robertshaw Pneumatic Engine Control System



Designed specifically for pipeline requirements, this new system is adaptable to all internal combustion engine installations.

Developed from standardized components—engineered and manufactured by Robertshaw for one-source responsibility—the system is fully pneumatic . . . and completely automatic.

It can monitor any number of measured variables of temperature, pressure, vibration, level, etc.; and instantly signals when any variable exceeds pre-set limits.

The Safety System prevents engine damage from malfunction or abnormal conditions by shutting down engine if condition is critical; if not, it signals a warning.

All start and stop operations are controlled in sequence and completely interlocked.

Every system is custom engineered to meet specific requirements, is tested as a complete system before shipment, and is backed by Robertshaw's world-wide engineering organization.

For further information, write for Bulletin JD-760. **Fulton Sylphon Division, Robertshaw-Fulton Controls Co., Knoxville 1, Tennessee**

Robertshaw® MR. CONTROLS

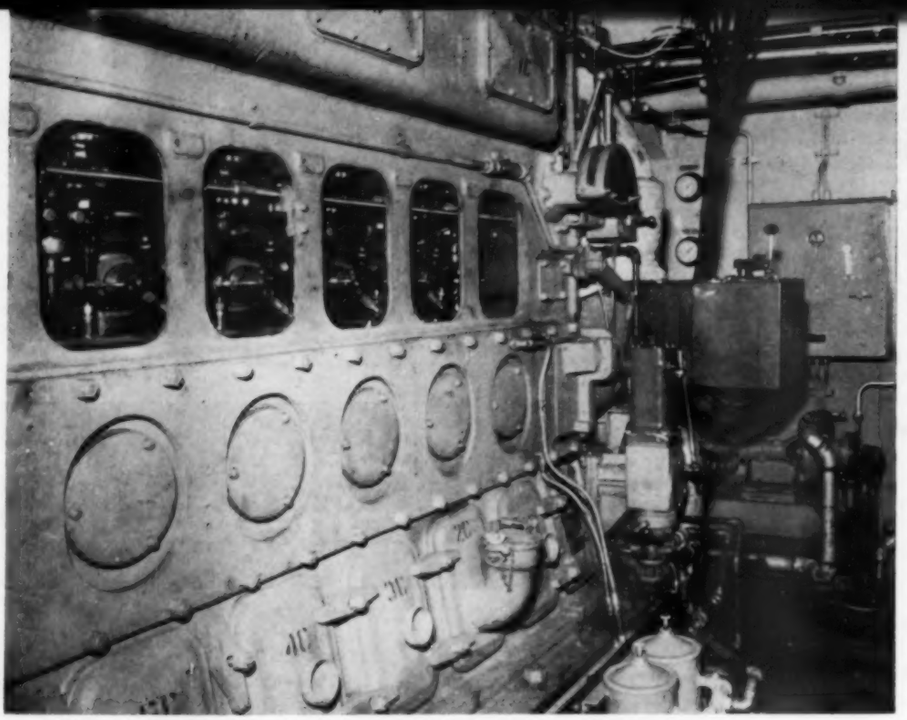
NEW TUG, *CHEMUNG*, IS VERSATILE

ONE of the most versatile tugs in the East has been completed at the Brooklyn yards of Ira S. Bushey & Sons and was put into service by the Spentonbush Fuel Transportation Co. The tug *Chemung* is powered by an 1800 hp Fairbanks-Morse opposed-piston diesel engine and is intended for work on the New York barge canal, coastwise service and in miscellaneous harbor towing.

Primary mission for the vessel is moving oil barges between the New York area and Great Lakes ports. The standard tow is a 20,000 bbl. barge, 241 ft. by 43 ft. 6 in. with 15 ft. depth and a deep V for the bow of the tug. Dimensions of the *Chemung* are: 90 ft. length overall, 25 ft. molded breadth, and 12 ft. depth. With her bow deep in the V of a barge, the *Chemung* has a compact tow, easily maneuvered and well within the size limits of 300 ft. canal locks. The pilothouse can be raised to provide maximum visibility in maneuvering a tow but can be lowered quickly, using a compressed air-operated hydraulic mechanism, to pass under fixed bridges on the New York barge canal.

The Fairbanks-Morse opposed piston diesel is a 10 cylinder, 8⅛ x 10 in. bore and stroke, two cycle engine rated 1800 cont. hp at 765 rpm. Driving through a Wichita clutch and 2.57:1 Lufkin reverse-reduction gears, the diesel turns a four-bladed 96x48 in. propeller at 298 rpm at full speed. A 25 kw generator is run by the main engine, driven off the reverse pinion shaft of the reduction gears, making it unnecessary to run the auxiliary when the big diesel is in operation. The auxiliary diesel is a Caterpillar which drives a 25 kw generator and a positive displacement fire pump. In addition, a 56 cell battery floats on the line.

Speed limitations on the barge canal don't permit the *Chemung* and her diesel to flex their muscles, but full power of the 1800 hp engine can be used on the Hudson River and Great Lakes as well as in coastwise and some harbor work.



Propulsion power is provided by this 10 cylinder FM opposed piston diesel rated 1800 hp at 765 rpm. Engine drives through Wichita clutch. Lufkin reverse-reduction gears. Note Woodward governor, Westinghouse Air Brake control.

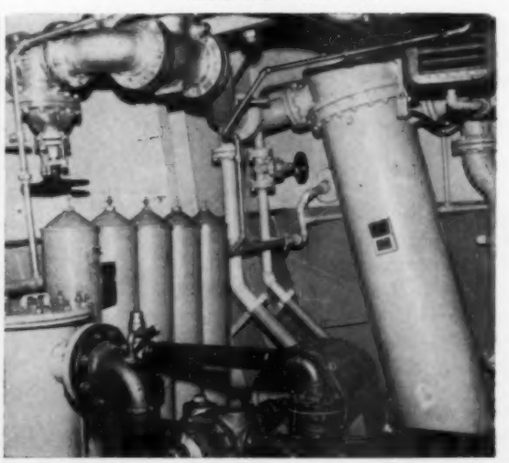
The primary cooling water, lubricating oil and fuel pumps are engine driven. The engine cooling system has one pump circulating fresh jacket water through the diesel and through a heat exchanger while a second pump sends raw water through the exchanger. All these pumps have motor-driven standbys. The jacket water also is used to cool the lubricating oil in a second heat exchanger. The lube system includes full flow filter, a ten element bypass filter and a motor driven auxiliary lube pump also used to circulate oil before starting the engine. Fuel is pumped through a duplex filter and a dehydrator. The vessel has capacity for 20,000 gals. of fuel oil, 2200 gals. of fresh water, 990 gal. of lube oil and 32 tons of ballast.

Engine starting air is supplied by a motor driven compressor. On the engine are a Woodward governor and Westinghouse Air Brake control for engine, clutch and gears. On the forward bulkhead is an engine panel with exhaust pyrometer and pressure gauges and steering gear alarm. The *Chemung's* captain is Joseph Mosso, a young veteran who served on his first Bushey boat in 1940.

Principal Equipment

Main engine	Fairbanks-Morse
Clutch	Wichita
Reverse-reduction gears	Lufkin
Heat exchangers	Ross
Lube oil filters	Air Maze
Fuel oil filter	Nugent
Starting air compressor	Quincy
Governor	Woodward
Engine controls	Westinghouse Air Brake
Exhaust pyrometer	Alnor
Exhaust silencer	Maxim
Thermostatic controls	Amot
Auxiliary diesel	Caterpillar

This view of the *Chemung* shows her pilot house down. Masts are hinged so that the vessel can pass easily under low bridges on the New York barge canal. This versatile tug is intended also for coastwise and harbor service.



Accessory equipment is grouped compactly and conveniently. This view shows the Air-Maze full-flo lube filter, Fairbanks-Morse cartridge-type lube bypass filter, Roper auxiliary lube pump, Ross lube cooler, and Amot thermostatic control valve.

Twin Disc Founder, Chairman Percy H. Batten, is Dead

P. H. Batten

Percy H. Batten, founder and chairman of the board of Twin Disc Clutch Co., died April 8 at Racine, Wis. During his 42-year career at Twin Disc, Mr. Batten earned a reputation as one of the nation's most able and progressive industrial leaders. He built the company from a tiny Racine shop employing eight people into a worldwide operation with 1200 employees. Mr. Batten was born in Naperville, Ill. in 1877. After graduating from Purdue University in 1898, he spent four years with the Northwestern Railroad. Thereafter he served in succession as manager for the receivers of the Chicago Motor Vehicle Co., general superintendent of the Featherstone Foundry & Machine Co., and general superintendent of the Western Division of the American Brake Shoe & Foundry Co. In 1913 Mr. Batten came to Racine as works manager of the Wallis Tractor Co. plant. Five years later he joined with Arthur B. Modine, a fellow Wallis engineer, and T. L. Fawick, inventor of a new farm tractor clutch, to form the Twin Disc Clutch Company. He succeeded Mr. Fawick as president in 1922 and served in that capacity until 1948 when he assumed the board chairmanship. Mr. Batten added many new products to the Twin Disc line, including power take-offs, reduction gears, marine gears, fluid couplings and hydraulic torque converters. During the war years, Mr. Batten served as director of the Racine Council, Navy League of the United States, and as a member of the Navy Industrial Committee and the Army Ordnance Association. Surviving, in addition to his son, John H. Batten, now president of Twin Disc, are his wife Lisa, seven grandchildren, and two great-grandchildren.

New Suction Dredge

St. Louis Shipbuilding & Steel Co. recently delivered the suction dredge *JOHN B* to the North West Electric Power Co-operative, Inc. The *JOHN B* is now operating at Missouri City, Mo., and is being used to keep the channel open to the condenser cooling water suctions of this large power plant. The hull is 80 ft. x 24 ft. x 4 ft. 4 in., is divided into eight water-tight compartments, and is protected by concrete filled fenders on both sides. The pump is a Kansas City Hay Press Co. Model XL, 12 in. suction, 10 in. discharge, belt driven by a General Motors Model 6061 diesel engine.

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HEAT EXCHANGERS

- Flanged baffles . . . pioneered by YA eliminate vibration wear and provide maximum efficiency.
- Rolled tube joints . . . industry accepted standard of quality construction.
- Single and Multiple Pass Designs . . . available in 2" through 10" diameters.
- Now available from stock.
- Ask for Bulletin HT-1A.

ENGINE COOLING RADIATORS

Over 75 years of service to industry

HEAT TRANSFER DIVISION

Yates-American

MACHINE COMPANY

703 4th St. BELOIT, WISCONSIN

Emergency Power Brochure

A new eight page brochure illustrating GM Diesel's line of diesel equipped standby generator sets has just been released. Titled *Emergency Power for Hospitals* the new brochure gives complete specifications information on GM Diesel's single and multi-engine generator sets. Copies of the brochure may be obtained by writing GM Diesel, Deroit 28, Mich. ITS NEW

3 F-M Promotions

Robert Aldag has been promoted to manager of Locomotive Product Sales for Fairbanks, Morse & Co. Mr. Aldag, who has been with Fairbanks, Morse since 1946, was formerly Manager of the Railroad Division. At the same time Hugh Donaldson was promoted to the position of central regional manager, Locomotive Product Sales, with headquarters at Chicago and E. J. Phillips was promoted to the position of eastern regional manager, Locomotive Product Sales, with headquarters at Fair Lawn, New Jersey.

Shim Facilities Bought

Shim facilities of National Seal Division, Federal-Mogul-Bower Bearings, Inc., Redwood City, California, have been acquired by the Laminated Shim Company, Inc. of Glenbrook, Conn., according to a joint announcement by A. V. Anderson, president of Laminated Shim, and Milton Bulkeley, general manager of National Seal Division. According to the announcement, all of the National Seal shim equipment is being moved to Connecticut, and production of some items will begin almost immediately. Two purposes will be served by the agreement, it was revealed, since it permits National Seal to concentrate its efforts on its oil seal and O-ring products, while the acquisition helps Laminated round out the expanding line of shims and stampings at its Glenbrook plant.

SIMPLICITY
in the Heart of the
Modern Diesel Engine
Simple—Only 8" long, 3¼" wide, 5½" high . . . weighs less than 10 pounds . . . fewer parts to service, fewer adjustments to make.
Versatile—Because of accessories that can be built in or added at low cost taking up no, or very little, valuable engine block space.
Economical—Initial cost is less, costs less to service, saves money because of its dependable service.
HMS
makes good diesels better
ROOSA MASTER
Write for guides to better fuel injection. One features the pump, the other an efficient, economical filter.
HARTFORD MACHINE SCREW CO., HARTFORD 2, CONN.
Division of Standard Screw Company

New Sales Engineers

Don B. Bramley and James C. Dangler have joined The Cooper-Bessemer Corp., as sales engineers, it was announced by George W. Edick, company manager of domestic sales. Mr. Bramley will work under the supervision of Mr. Frank J. Hunter, Cooper-Bessemer St. Louis Branch Manager. Headquartering at Kansas City, he will serve as a specialist in the sale of Cooper-Bessemer gas, diesel and gas-diesel engines for municipal power plants and other stationary power services in the Missouri, Kansas, Nebraska, Iowa area. He is already well known in this area, having been actively associated with municipal power application here for a number of years. Mr. Dangler will work under the supervision of Fletcher M. Devin, Cooper-Bessemer vice-president and district sales manager of the East–Central Sales District. Since 1947, he has been associated with the Oster Manufacturing Co., Cleveland. His last position with that firm was assistant to the president.

West Coast News

By James Joseph

SHIPPED: by Whittier, Calif.'s Shepherd Machinery Co., seven Caterpillar D353 diesel electric sets (with Electric Machinery generators), rated 900 rpm at 150 kw to overseas U.S. Defense Dept. agency.

OPERATING winch on Terminal Island, Calif. tuna clipper is a GM 3061-A with Twin Disc Torque converter. Sale by Anderson-O'Brien Co., San Pedro, Calif.

TO Grand Junction, Colorado, mine operators: a number of Getman Model KD2 Scoot Crete Ore Carriers with F2L-712 Deutz diesel engines. Sale reported by Diesel Energy Corp.

SOLD: to Alhambra, Calif.'s Vinnell Corp. for Pakistan job, four Murphy diesel generator sets (110 kw at 160 hp continuous) with Electric Machinery generators. Sets, with new MP-21 Murphys, sold by Industrial Engine Service, Los Angeles.

FOR Ed Locke's new cruiser, *Pau Hana*, built by Lindwall Boat Works, Santa Barbara, Calif., a Caterpillar D-330 turbocharged (100 hp at 1800 rpm) diesel swinging 38x32 wheel thru 4:1 Capitol gearing.

FOR Pacific Dredge's San Pedro-working dredge, a GM 3031-C, 3-71 diesel, as auxiliary power unit.

AS main propulsion for motor cruiser *Bos'n*, owned by Mr. and Mrs. Jim McDonald, a GM 3071-A. Sale by Anderson-O'Brien Co., San Pedro, Calif.

INSTALLED in an abalone boat owned by Frank Brebes, Morro Bay, Calif., a GM 4-53 diesel with 2:1 reduction.

FOR cruiser *Hobo*, owned by Graham Truman and built by San Pedro's F & T Boat Works, a Caterpillar D-326 (131 hp at 1600 rpm) as main propulsion, the engine working thru Capitol gears.

TO Macco Corp., a Murphy model 122 driving Palmer generator, the set rated 140 kw, 205 hp continuous at 1200 rpm. Sale by Industrial Engine Service, Los Angeles.

CATALINA Island Sightseeing Lines has purchased, as main propulsion for its 65 ft. aluminum water taxi, two GM V-12s with 2:1 reduction. Boat was designed by Sparkman & Stevens, is being built by San Diego's Chaffe Machine Works.

TO Douglas Aircraft Company for marine vessel *Pacific Retriever*, a GM 4-71 generator set, rated 40 kw.

A Caterpillar D-315 turbocharged diesel working a 38 x 32 Federal prop thru Capitol 4:1 reduction is main propulsion for Gifford Davidge's new 48 ft. cruiser, abuilding in Lindwall Boat Works, Santa Barbara, Calif. Engine is rated 80 hp at 1800 rpm. Sale by Shepherd Machinery Co., Whittier.

TO R. A. Briggs & Sons, Roseburg, Ore., 18 new International-Harvester model RDF-405 logging trucks with 300 hp Cummins NHRB-6-B engines, 10 speed main and three speed auxiliary transmissions.

FOR the towboat *Case Ace*, owned by Pacific Towboat & Barge Co., Long Beach, Calif., a GM 12V-71, for main propulsion. Sale reported by Anderson-O'Brien Co., San Pedro.

INSTALLED: a GM 8V-71, in the 46 ft. Willis Craft owned by Ward Poulson, Rolling Hills, Calif.

A GM 8V-71 diesel has been installed in the cruiser *New Hustler*, owned by George Mio, Wilmington, Calif.

FOR Art Kates' 60 ft. yacht now being built in the Los Angeles area, two GM 6-71s (a model 6071 and 6072-A). Sale by Anderson-O'Brien Co.

AS main propulsion for a Monterey-type motor cruiser owned by H. C. Battaglia, San Marino, Calif., a GM 3-53 with 3:1 reduction.

TO Lee Cochran, San Pedro, Calif., for his towboat *Vivo*, a GM 6-110.

Inland River Reports

By A. D. Burroughs

TWIN 1600 hp GM Cleveland engines produce the 3200 hp for the *Franklin Pierce*, newest towboat in the Thomas Petroleum Transit (Butler, Pa.) fleet. Falk reduction gears and Wichita clutch equip this Dravo-3200, scheduled for runs between Gulf ports and Pittsburgh terminals.

JOE LUCAS, new 63x21 ft. towboat completed by Barbour Metal Boat Works, St. Louis, for Ohio River Sand and Gravel Corp., W. Va., has a rated 600 hp from a pair of Caterpillar model 353 engines.

KEELS have been laid for two unnamed twinscrew crafts at Humboldt Boat Service, St. Louis. A 330 hp craft will go to Al Cravens, Caruthersville, Mo. A 440 hp craft will go to Clyde Allgire, St. Louis.

ROCKLAND COUNTY, first push-type diesel towboat designed for Hudson River service, has been delivered by Dravo Corp. to the Cornell Steamboat Co. The 105 x 30 ft. vessel has 1800 hp delivered from a pair of Fairbanks-Morse engines.

INSTALLATION of Cummins NRTO-6-N engines, Twin Disc model 512 hydraulic gears and Morse controls gives the towboat, *Alton*, a power-boost to 440 hp for performance for owner Norman Brothers, Inc., Alton, Ill. Installation aid was given by Cummins Missouri Diesel Sales Corp., St. Louis.

CAROL BRENT, 66x22 ft. towboat, is the newest fleet addition for the Brent Towing Co., Greenville, Miss. The craft will see service in the chemical trade from Lake Charles, La., to Memphis, and Peoria, Ill.

CONSTRUCTION is underway on the second towboat to join the Brent fleet. The towboat, *Ann Brent*, will measure 110x32 ft. and is scheduled for a rated 3200 hp from two 1600 hp engines.

THE Vest Towing Co., Greenville, will gain its largest towboat with the completion of the craft under construction at Vest Transportation Co. The towboat will produce a total 3200 hp from two engines. Plans indicate a measurement of 120x34 ft.

ANOTHER un-named craft under construction at Greenville is a harbor boat for Superior Towing Co. The 51x18 ft. craft will be equipped with two unselected 165 hp engines.

A 200 hp Cummins engine will power the new towboat under construction at Walker Boat Yard, Paducah, Ky. The 40x12 ft. craft will see ferry service for Cave-In-Rock (Ill.) Ferry Co.

THE big *Lachlan Macleay* was one of the first towboats opening the season on the Missouri River. This 1955 production from St. Louis Shipbuilding and Steel Co. is in action for Federal Barge Lines with 3600 hp from four GM engines.

ON the Upper Ohio, the *OVEC* was active in the coal trade for owner Ohio River Co. Built in 1956 by St. Louis Ship, the towboat has 3240 hp supplied by three Baldwin-Lima-Hamilton engines.

THE *Theresa Seley*, another busy Ohio River towboat was spotted making good performance with 6000 hp delivered from Nordberg Supairthermal engines.

THE familiar Mississippi River towboat, *William S. Lyon* has been sold to Louisiana Towing Co., Lake Providence, La., by Superior Towing Co. The 100x 30 ft. towboat, built in 1955, has 1800 hp from two GM engines.

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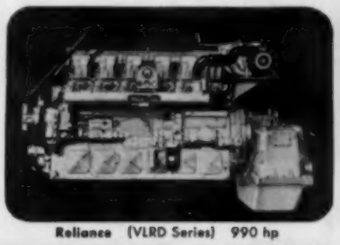
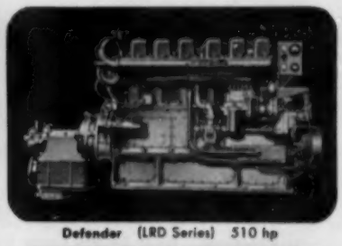
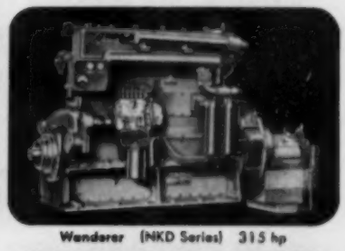
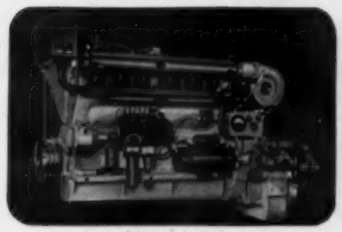
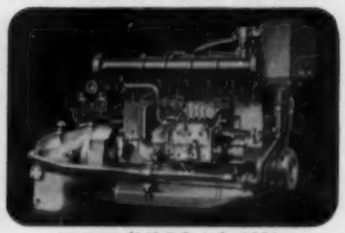
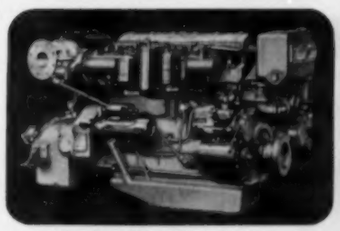

Reliance (VLRD Series) 990 hp

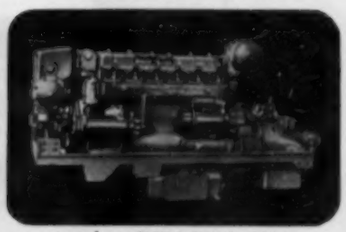

Defender (LRD Series) 510 hp


Wanderer (NKD Series) 315 hp


Resolute (WAKD Series) 290 hp


Vigilant (148-D Series) 195 hp


Cutwater (135-D Series) 120 hp


Navigator (197-D Series) 85 hp

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for fishing vessels... tugs... towboats and work craft of all types

Engine	Type	Cyls.	Bore & Str.	Displ.	24-Hr. Max Rating
RELIANCE	Normal	12	8½ x 8½	5788	725 hp @ 1215 rpm
	Turbo	12	8½ x 8½	5788	990 hp @ 1215 rpm
DEFENDER	Normal	6	8½ x 8½	2894	335 hp @ 1215 rpm
	Turbo	6	8½ x 8½	2894	510 hp @ 1215 rpm
WANDERER	Normal	6	7 x 8¼	1905	240 hp @ 1215 rpm
	Turbo	6	7 x 8¼	1905	315 hp @ 1215 rpm
RESOLUTE	Normal	6	6⅛ x 6½	1197	195 hp @ 1600 rpm
	Turbo	6	6¼ x 6½	1197	290 hp @ 1600 rpm
VIGILANT	Normal	6	5⅛ x 6	779	150 hp @ 1800 rpm
	Turbo	6	5⅛ x 6	779	195 hp @ 1800 rpm
CUTWATER	Normal	6	4¼ x 5	426	100 hp @ 2000 rpm
	Turbo	6	4¼ x 5	426	120 hp @ 2000 rpm
NAVIGATOR	Normal	6	4 x 4	302	65 hp @ 2000 rpm
	Turbo	6	4 x 4	302	85 hp @ 2000 rpm

WRITE FOR DESCRIPTIVE LITERATURE

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640 HP M/V E. F. Campbell

The new 640 hp twin screw towboat *E. F. Campbell* was recently delivered to the Ohio River Co. of Cincinnati. Built by St. Louis Shipbuilding & Steel Co., the "Campbell" design is patterned after the *Tom Ragsdale* and the *Des Plaines* built by St. Louis Ship. Hull dimensions are 90 x 28 x 9½ ft. with a normal draft of 6 ft. 6 in. and the vessel is ruggedly framed transversely and longitudinally with the shell plating unusually heavy. The *Campbell* has a model scow bow and the stern lines were developed for best possible integration of kort nozzles and tunnels.

Propulsion power is provided by two 320 hp Caterpillar model D-397 series D turbocharged diesels with Twin-Disc reverse reduction gears turning four-blade, 72 in. diameter stainless steel propellers. The engines are controlled from the pilot house and engine cooling water is circulated through a skin cooling system. Hull tanks carry 16,000 gals. of fuel oil. Two 75 kw Caterpillar diesel generator sets provide main auxiliary power. The *Campbell* is equipped with two mechanical-hydraulic steering systems, one for the two steering rudders and one for the four flanking rudders. Steering control is mechanical, follow-up type; the position of the steering levers corresponding precisely to the position of the rudders.

Principal Equipment

Main engines	Caterpillar
R & R gears	Twin-Disc
Turbochargers	Garrett
Compressor	Quincy
Fuel oil filters	Hilliard
Air cleaners	Donaldson
Diesel generator sets	Caterpillar
Exhaust silencers	Burgess-Manning

Cerlist Engines Repower Buses

Repowering of a school bus and two city buses with Cerlist model 3 diesel engines was reported to have improved fuel consumption as much as six mpg. A school bus belonging to the state of North Carolina and two vehicles owned by M&B Transit Lines, Burlington, N.C. were converted without drive line changes or weight penalties, according to the engine builder. The model 3 is rated 85 hp at 3,000 rpm and has a piston displacement of 170 cu. in. The school bus, an International-Harvester L160, formerly had a gasoline engine rated 140 hp at 3800 rpm. The 69 passenger, 16,000 gvw vehicle carries students of the Alexander Wilson school south of Graham, N.C. on a 38 mi. daily round trip. For the installation the Cerlist model 3 was equipped with an adapter ring on the flywheel housing and an adapter hub on the flywheel to move the shorter engine forward to clear the firewall. Front support brackets for the engine were made and fastened to the front cross member of the chassis, the vacuum-boost brake system was provided with a vacuum pump driven by a v-belt pulley adapter from the crankshaft pulley and a removable panel in the firewall was provided to give access for timing adjustments on the fuel pump drive gear.

Top, 68 passenger International-Harvester L160 school bus owned by the state of North Carolina and recently repowered with a Cerlist model 3 diesel engine. Fuel consumption of 11.5 mpg, an improvement of six mpg was reported since it went into service. Lower, Cerlist engine in I-H L160 school bus. The shorter diesel engine was fitted with adapter ring on the flywheel housing and a hub on the flywheel to move it forward in the engine compartment.

The school bus was put into service with the new engine in April, 1959 and averaged 10.6 mpg compared with 6.1 mpg reported for the gasoline engine. The bus makes 50-60 stops in its daily run. Although usage factor in this type of service is low, the relatively long life of the buses, 10-12 yrs., affords an ample period for amortization of the higher cost of the diesel engine through reduced fuel and service costs.

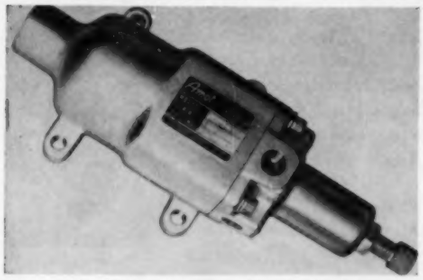
The two transit buses, one a Ford-Transit, 1946, the other a GM TGH-2708, average about 200 mi. each on their daily runs. Installation of the Cerlist model 3 in the Ford-Transit unit was made with minor modifications of the flywheel and clutch and engine supports. A new radiator was installed and a bracket to support the air compressor for the brakes was fabricated. A conversion kit to install the Cerlist in the GM bus was developed and used in that installation. The removable engine support rack makes conversion of these coaches particularly easy. The Ford-Transit bus has now been operated for about 15,000 mi. Fuel consumption reported in service, which includes over-the-road charter service was reported as 11.5 mpg of No. 2 diesel fuel compared with 5.5 with the original 140 hp gasoline engine. The GM bus is reported traveling 10.6 mpg with the new engine.

Western Gear Buys New Manufacturing Facility

A half-million-dollar modernization and expansion program and entrance into the consumer boating market have been announced by the Western Gear Corp., of Lynwood, Calif. Western Gear has purchased a former U.S. Navy shipyard at Everett, Wash., and also bought the Seapower outdrive, according to recent announcements by the firm. Acquisition of the Everett manufacturing facilities will pave the way for relocation of the Seattle plant of the industrial products division of Western Gear. T. J. Bannan, president of Western Gear, in announcing the program, emphasized that the firm does not intend to enter the shipbuilding field but will continue to supply the marine market with equipment such as deck machinery, propulsion gears, steering engines and mechanisms. The industrial division of Western Gear specializes in marine deck machinery for military, naval and commercial vessels. Coincident with announcement of the Seapower purchase, it was stated that the outdrive units will be manufactured and marketed by Western Gear's Southwestern division plant at Houston, Texas and that $250,000 has already been earmarked for plant enlargement and necessary new tooling and machine equipment. Name, design and inventory of Seapower outdrive was purchased by Western Gear from Sweinhart Equipment Sales, Inc., and Tison Engineering, Inc., both of Los Angeles.

Major manufacturing facilities of a mothballed U.S. Navy shipyard at Everett, Wash., acquired by Western Gear Corporation, for expanding and moving its industrial products division.

New Vibration Valve



The model 2900 vibration valve is the latest addition to the Amot Controls Corp. line of safety and automatic system components. Employed as a two or three-way, snap acting, non-overlap vibration monitoring valve on pneumatic or hydraulic control systems to 80 psi, the unit is adaptable to engines, compressors, fans, motors and other rotating or reciprocating equipment. The model 2900 may be applied as an accessory to the 1476 line of basic Amot controls, or it may be used by itself to energize auxiliary devices. Sensitivity of the valve is manually adjustable and it is sensitive to vibration from any direction in the plane perpendicular to its longitudinal axis. An internal cylinder is provided which will reset the tripping mechanism, with the application of 40 to 80 psi. The reset cylinder may also be used in a time-delay circuit to prevent tripping of the valve on high amplitude vibrations during start-up. For Bulletin #493 write Amot Controls Corp., Box 1707, Richmond, Calif. (ITS NEW)

Operations Vice President

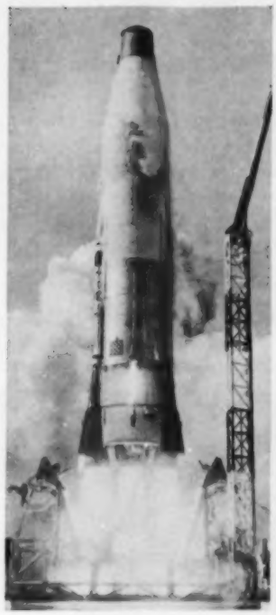
C. E. Richardson

C. E. Richardson has been chosen vice president—operations by the board of directors of Gillett & Eaton, Inc. Mr. Richardson was also elected Vice President—Operations of the Arrow Head Steel Products Co. at Howell, Mich., a subsidiary of Gillett & Eaton. He joined the company as shop superintendent in April, 1955; and in April, 1958 was appointed sales manager.

Name Sales Vice President

M. J. Sullivan

American Marc, Inc., Inglewood, Calif., manufacturers of small, lightweight diesel engines, generators and diesel marine pleasure craft, recently announced the appointment of M. John Sullivan of Silver Springs, Md., as vice president and general sales manager in charge of Washington, D.C. sales. Mr. Sullivan, a New York State Maritime College graduate engineer, recently joined American Marc after eight years with Consolidated Diesel Electric Corp. of Stamford, Connecticut, where he had been acting general manager. Mr. Sullivan will direct sales of the company's engines and generator sets to the military and industry, as well as the company's line of marine pleasure craft, and the diesel outboard motor, which American Marc began producing in January.



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Vapor-Phase® Steam Separator

This heat is "processed" in Vapor Phase Steam Separators and Exhaust Heat Boilers, and incorporated into the absorption refrigeration system which cools the underground computers, radar equipment and other apparatus. Equally interesting are Vapor Phase installations at radar bases which recover engine heat to warm living quarters for the entire staff.

Vapor-Phase® Exhaust Heat Boilers

These are two of many, many uses for Vapor Phase cooling and heat recovery. Perhaps you are overlooking an opportunity in your own operation to turn a liability into an asset with Vapor Phase. Write today for more complete information about this remarkable system.

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Positive Connection Coupling

Development of the new 3750 SAF-LOC self-sealing coupling for use in aircraft fuel, oil, low pressure hydraulic, pneumatic, and other systems has been announced by Aeroquip Corporation, Jackson, Michigan. The coupling is especially designed to provide fast, safe connections, in applications where positive, foolproof locking is mandatory. Hence, there is no stable, partially connected position permitting fluid to flow. In addition, three check points are used to verify positive connection: 1) sound—an audible click action; 2) visual—indicator pins protrude externally when coupling is locked; 3) touch—position of indicator pin can be determined manually. Aeroquip Saf-Loc couplings connect and disconnect with a single, one-hand movement. The positive thread action of the nut gives a mechanical advantage that permits connection against line pressures ranging up to 60 p.s.i. Yet the coupling will not disconnect accidentially even under the forces applied in operation up to 20 G's. The couplings have been tested in accordance with MIL-C-7413A. They are available in various end fitting configurations. Special adaptations of the coupling can be made upon request. Further information about the Saf-Loc coupling is available from the Advertising Department, Aeroquip Corporation, Jackson, Michigan.

ITS NEW

Florida C160 Installation

An early installation of the new C160 Cummins automotive diesel engine, in Florida, was in the newly repowered Mack highway tractor owned by Hunt's in Miami. Installation included the original Mack TR771 five speed transmission and 6.20:11 ratio axle, a Riker muffler, Luberfiner lubricating filter and Bendix-Westinghouse air compressor. These new six cylinder C160 Cummins diesel engines have a bore and stroke of $4\frac{7}{16}$ x 5 in. and a piston displacement of 464 cu. in., they develop 160 hp at 2500 rpm and the net weight with standard accessories is approximately 1555

lbs. The new installation replaces a 145 hp gasoline engine and was engineered and installed at the new shops of Cummins Diesel Sales Corp. in Hialeah, Florida.

Fairbanks, Morse Marketing V.P.

S. E. Wolkenheim

Stanley E. Wolkenheim has been appointed vice president, Marketing, of Fairbanks, Morse & Co. it was announced by Robert W. Kerr, president. Mr. Wolkenheim is transferring to Fairbanks, Morse from the A. O. Smith Corp., Milwaukee, where he has been director of marketing since 1955, and vice president since 1957. He joined A. O. Smith Corporation in 1949, after ten years with Hotpoint, Inc., an affiliate of General Electric, as manager of the Range-Heater Division, with time out for service in the United States Navy during World War II.

EMD Promotion

J. K. Williams

Appointment of John K. Williams as assistant director of public relations for Electro-Motive Division of General Motors is announced by Robert D. Innes, director of public relations for Electro-Motive. He was director of radio and TV relations for two large Chicago area sports organizations prior to his appointment at Electro-Motive.

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with these features:

- High flow rates
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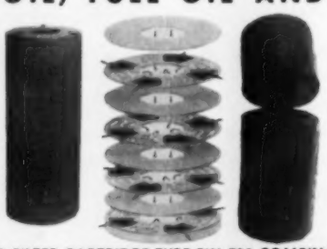
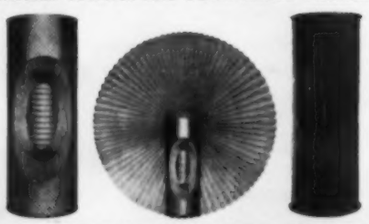
- In-out pressure gauges
- Quick action cover lifter
- 100 psi standard design pressure
  Higher pressures upon specification
- Swing bolt cover construction



HILCO FILTER CARTRIDGE TYPE FW-718 COMBINATION EXTENDED SURFACE AND DEPTH MICRO FILTRATION



HILCO FILTER CARTRIDGE TYPE PL-718 EXTENDED SURFACE FOR EXTREMELY HIGH FLOW RATES

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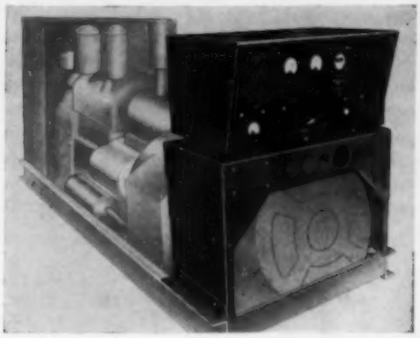
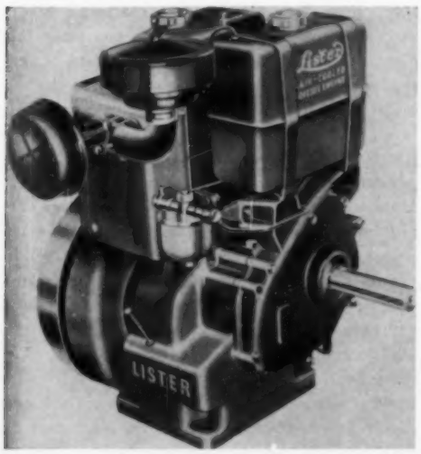
Modular Control Panels



The Simplex Modular Panel system brings a "building block" approach to the control of small and medium size engine generators. Flexibility and elimination of service problems in the field are the main objectives of this system. The modular concept is thoroughly carried out to provide an answer for the simplest to the most complex control requirements. Over 250 stock instrumentation and control modules are available to provide an unlimited variety of panel configurations. All metering and control functions are isolated into self contained quick change modules. The modern requirements of availability, versatility, and serviceability plus high quality and reliability dictated design of the functional control system. For bulletin 2A-1456B, write The Simplex Co., 1139 N. MacArthur Blvd., Springfield, Ill. (ITS NEW)

New Lister Engine



Lister-Blackstone, Inc. announced the introduction of their Models SL1 and SL2 now available at 2000 rpm. The model SL1 is now rated 4.75 bhp at 2000 rpm, and the model SL2 rated 9.5 bhp at 2000 rpm. The model shown is the single cylinder SL1.

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SF 211 – Shown above, left, the all-purpose, single wire braid hose assembly suitable for universal industrial applications. Withstands temperatures from –40°F to 250°F.

SF 213 – Shown above, center, the lightweight single wire braid, fabric covered hose assembly designed for hot engine oil and fuel lines and many other applications. Withstands temperatures from –40°F to 300°F.

SF 224 – Shown above, right, the high temperature stainless steel wire braid covered Teflon hose assembly, designed for chemicals, petroleum or synthetic base lubricants, acids, solvents, steam service and hot asphalt lines. Withstands temperatures from –65°F to 450°F.

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Both manufacturers and users of diesel equipment can rely on Stratoflex flexible hose and hose fittings to reduce downtime, speed replacements and hold maintenance costs to a minimum. Stratoflex hose has the proven durability that is necessary for dependable service. Stratoflex detachable and reusable fittings simplify maintenance and assure vibration-proof, leak-proof connections. Hose lines can be made up rapidly on the job, thus reducing costly downtime. For complete information on Stratoflex diesel-proved hose and fittings, write for Industrial Catalog 201.

SF9-0

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Toronto, Tulsa

Open Research Center

New research laboratories, housed in a newly-constructed half-million dollar building with more than 13,000 sq. ft. of floor space, were opened recently at Purolator Products, Inc., Rahway, N. J. The new research center, according to James D. Abeles, company president, will be devoted to pure research and new product development with provisions for pilot production. The company's major products are filters and filtration equipment. "With this expansion," Abeles said, "the company's Research and Development Department will be able to conduct not only new filter media research but also studies in how present media materials may be used in a diversified field of industrial and commercial products." Described as the most complete filtration research facility in the country, the new center contains four major sections, including two chemistry labs, a mechanical lab, pilot plant manufacturing area, library, and offices. The laboratories contain photographic and microscopic equipment for studying every type of contaminant and a complete metallographic lab for the study of all types of metals. Filtration test loops for air, water, and other fluids will be used to study various filter media under almost any environmental conditions.

Fuel Oil Pressure Gauge

The new Maintenance Minder fuel oil pressure gauge is designed to give accuracy and utility to solve problems of trouble-shooting a balky fuel supply system. The pressure gauge is calibrated from zero to 100 lbs. of pressure per sq. in., for positive readings at any pressure range. Also, the gauge face is divided to indicate safe and unsafe zones of pressure for easy diagnosis of faulty lines, primary or secondary fuel filters or fuel pump. By

connecting the fuel oil pressure gauge to the input side of the secondary fuel filter, a low pressure reading would indicate either the primary filter needs replacing or the fuel pump is faulty. A wavering needle would mark an air leak in the lines or too much pressure would indicate a restriction on the line. Or, when the gauge is connected to the output side of the secondary fuel filter comparison between the first and second readings would indicate the condition of the secondary fuel filter element. Any point on the fuel line can be checked and compared between the pump and the secondary fuel filter to track down pressure variations. Other uses can be made of the Maintenance Minder fuel oil pressure gauge. Engine oil pressure readings may be made at many points on the oil lines and comparative results noted to determine unusual pressure variations. The permanent fuel and engine oil pressure gauges may also be checked to see that they are giving accurate information to the operator. The gauge is in a heavy gauge steel case fitted with a convex plastic lens, and equipped with a length of oil and flex-resistant Aeroquip hose, and all with brass fittings. The complete gauge assembly comes in its own steel carrying case. For further information about the Maintenance Minder twins, write direct to R. V. Hicklin, Hicklin G.M. Diesel, 5425 Second Ave., Des Moines, Iowa. (ITS NEW)

Building Diesel Engine Center

Cummins Sales & Service, Inc. distributors of Cummins Diesel Engines in the Mid-Continent region, is completing plans for a new diesel engine center to be constructed in the Great Southwest Corp.'s Arlington, Tex., industrial center. This was announced by K. W. Davis, board chairman of the company now headquartered in Fort Worth. It is scheduled for completion in August. The building proper will cover approximately 58,000 sq. ft.

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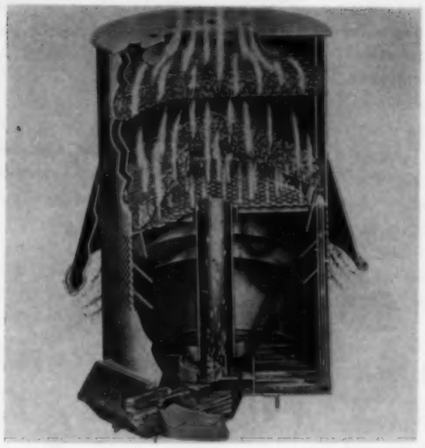
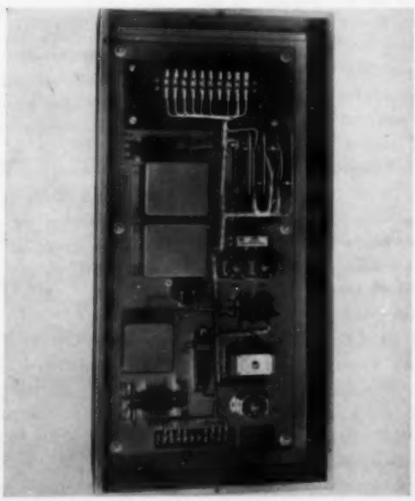
New Oil Bath Air Cleaner



An oil bath air filter with a pneumatic oil lift and no moving parts has been introduced by American Air Filter Co. The redesigned model "C" PO1 Cycoil is said to combine advantages of an automatic self-cleaning air cleaner with extremely high efficiency and low maintenance requirements. Major improvement in the Model "C" Cycoil is the pneumatic lift, a simplified method of lifting oil from the reservoir to the perforated oil distribution plate, which in turn distributes the oil to the pads. This replaces the motor-driven oil circulator used in previous models and eliminates the need for provision for electrical power. Other changes in the model "C" PO1 Cycoil include a new cleanout door for easier maintenance, the addition of a "bullseye" gauge to observe and help control the oil level in the unit, and elimination of studs sticking out of the top of the unit. PO1 Cycoils are installed as air cleaners on engine intake on gas and oil transmission lines, at refineries, natural gasoline plants, and municipal power plants. Bulletin 160, which describes the operation of the new model "C" PO1 type Cycoil oil bath air cleaner, is available upon request from Dept. PD, American Air Filter Co., 215 Central Ave., Louisville 8, Ky. (ITS NEW)

Voltage Regulator-Exciter

"Fincor" F-33, a voltage regulator-exciter of the tubeless magnetic-amplifier type, provides a compact means of regulating the output voltage of any 60-cycle generator or exciter requiring a full-load d-c field supply of from 10 to 25 amperes at 130 volts or less. In effect, it makes the generator self-exciting since the a-c input power of 208 to 240 volts, 60 cycles, is obtained either directly from the generator, through 220-volt taps on a 440-volt generator, or through a 440/220-volt transformer on the generator output. For applications to generator sets in the higher frequency range of 400 to 20,000 cycles, separate 60-cycle excitation may be used with a special sensing circuit. An additional model is also available for use on self-excited 400-cycle generators. The regulator comes assembled on a panel 19 inches wide by 24½ inches high or can be supplied mounted in a standard cabinet-type enclosure for wall or rack mounting. All connections are made to a screw-type terminal strip at the bottom of the regulator panel. For more information, write Fidelity Instrument Corp., 1000 E. Boundary Ave., York, Pa. (ITS NEW)



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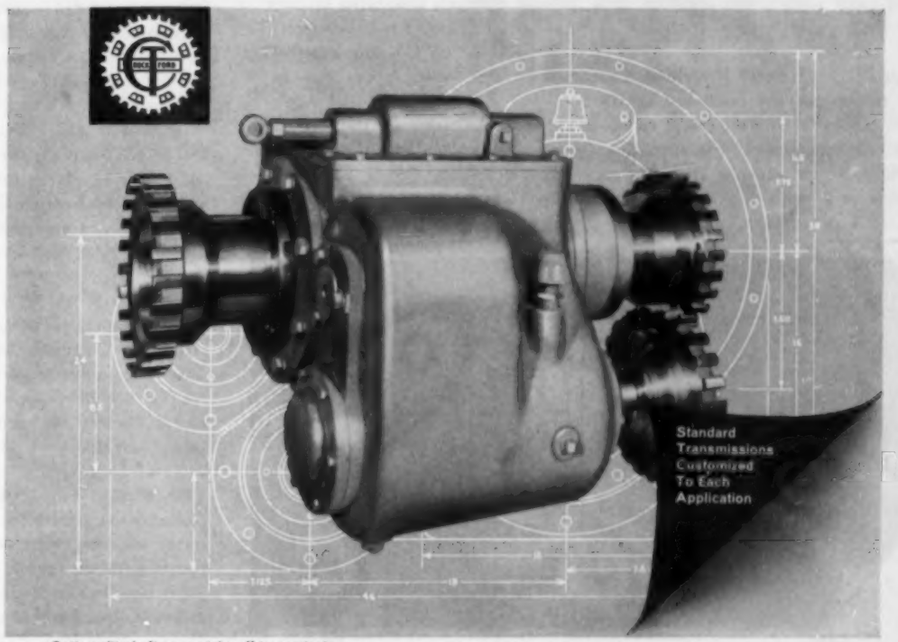


Cotta split-shaft power take-off transmission

Use full engine power for truck travel or auxiliary equipment with Cotta split-shaft power take-off

Need truck mobility to transport auxiliary equipment quickly . . . *plus* full engine power for pumps, winches, electric sets, and compressors after they arrive on the job?

Cotta's split-shaft power take-off transmissions lead full engine horsepower to rear axles, *or* to auxiliary equipment when heavy loads demand it. Auxiliary engines can be eliminated. Reduced gear loads and constant mesh gears on both shafts prolong equipment life.

PTO flexibility — Standard truck transmission ratios combine with Cotta's split-shaft ratios to provide exceptional drive flexibility for road travel or PTO performance. Customized gear-ratio variations are available for individual jobs.

Parts availability — Guaranteed Cotta parts and service keep your equipment on the job. Round-the-clock expediting of gears or shafts means delivery in hours after your order is received.

See our Catalog No. 3a/Co in *Sweet's Product Design File.* Check the descriptions of standard and custom applications. Then call Cotta (TWX-RK 7720 or phone WO 4-5671) for complete details.

COTTA
HEAVY-DUTY TRANSMISSIONS

COTTA TRANSMISSION CO., ROCKFORD, ILL.

Michigan-Ohio News

By Jim Brown

WIRT Transport Co., of Bay City, Mich. has accepted delivery on a new Hough model H-90 Payloader powered by a Cummins JN-6-BI diesel engine. The new Hough will be used for gravel loading work and was purchased from Wolverine Tractor and Equipment Co. of Detroit and Grand Rapids.

EDWARD C. Levy Contracting Co. of Detroit has accepted delivery on an Allis Chalmers model HD16 DC diesel tractor equipped with a cable bulldozer blade and cable control unit. Sale was made by Earle Equipment Co. of Detroit.

MICHIGAN Tractor & Machinery Co. of Detroit has just completed the first two of a series of "cost study" meetings for small contractors. The meetings are held to better acquaint the small contractor with methods of figuring operating costs, ownership costs, etc. and will be conducted in the future throughout the state of Michigan by Michigan Tractor & Machinery Co.

AUBURN Heights Gravel Co. of Pontiac, Mich. has accepted delivery on a Cummins NHS-6-P power unit for their 8 in. gravel pump. Sale was made by Cummins Diesel Michigan Inc. of Dearborn, Mich.

A new 11,000 lb. capacity rubber tired tractor shovel has been introduced by Pettibone Mulliken Corporation, Chicago. Designated the model PM-440, it is the largest in a new line of Speedall Tractor Shovels now being brought out by the company. Power is supplied by either a 152 hp GM Diesel or a Cummins diesel engine.

OCEANA County of Hart, Mich. has accepted delivery on a new International model TD-20 tractor. Sale was made by Wolverine Tractor & Equipment Co.

ED. C. Levy Co. of Detroit now has a new Koehring model 1205 shovel (3½-yd. bucket). Powered by a Cummins NHRS-6-ITC diesel engine, the shovel has 154 in. x 120 in. crawlers and 36 in. shoes. Sale was by Earle Equipment Co.

SPECIAL machinery recently built in Michigan Tractor & Machinery Co.'s "custom service shop" include a Caterpillar D-4 tractor converted for use as a hydraulic lift for cement blocks and materials, with a reported "3rd floor" reach. This unit was built for Darin & Armstrong Co. of Detroit.

TELFORD Equipment Co. of Detroit has appointed Bill Tucker as sales representative for Wayne and Washtenau Counties. Mr. Tucker was formerly with G. E. and now makes his home in Novi, Michigan.

INTERNATIONAL Salt Co. of Detroit has repowered a Hough HOD Payloader with a 120 hp Cummins model JN-6-BI diesel engine. Installation was done by Cummins Diesel Michigan Inc. of Dearborn.

A Galion model 118 Motor Grader powered by a Cummins model NHC-4-BI diesel engine was recently sold to Arenac County in Omer, Michigan. Sale was made by Wolverine Tractor & Equipment Co.

THE City of Flint, Michigan has accepted delivery on a Joy model RP-205 rotary air compressor powered with a Hercules diesel engine. The compressor is mounted on four pneumatic tires and is equipped with double hose reels. Sale was made by Earle Equipment Co.

DINVERNO Sons of Warren, Mich. has commissioned Cummins Diesel Michigan Inc. to repower their LF Mack tractor with a new naturally aspirated Cummins C-160-B diesel engine. The model C-160-B is designed for "stop-and-go" service and is rated at 160 hp at 2500 rpm.

CHRIS Nelson & Son of Royal Oak, Mich. has accepted delivery on a new Hough model H-90 Payloader powered by a Cummins JN-6-BI diesel engine. Sale was by Wolverine Tractor & Equipment Co.

BERNARD Eddel of Manistee, Michigan has accepted delivery on an Allis-Chalmers model D-17 (utility) tractor equipped with a Henry 710 loader (⅝-yd. bucket) and powered with an A-C diesel engine. Sale was made by Earle Equipment Co.

ANOTHER "custom-made unit" by Michigan Tractor & Machinery Co. of Detroit is a drilling rig mounted to the rear end of a Caterpillar model D-8 tractor. The drilling rig is powered by a Gardner Denver air compressor and will be used in drilling blast holes for Michigan Silica Company.

BRIGGS Construction Co. of Terrysburg, Ohio has commissioned Cummins Diesel Michigan Inc. to repower their Michigan model 125-A loader with a Cummins JN-6-CI diesel engine.

A Hough model H-70 Payloader powered by a model JN-6-BI Cummins diesel engine was recently sold to Marrocco Equipment Co. of Warren. Sale was made by Wolverine Tractor and Equipment.

EARLE Equipment Company recently delivered a model HD6E Allis-Chalmers tractor with hydraulic dozer blade to Sam Canonie of Covert, Mich.

CUMMINS Diesel Michigan Inc. has converted a fleet of eight model B-70 Mark tractors to diesel engine, using the Cummins NH-220-B. The installations were made for Mackinaw Company of Essexville, Mich.

Mid-West Diesel News

By L. H. Houck

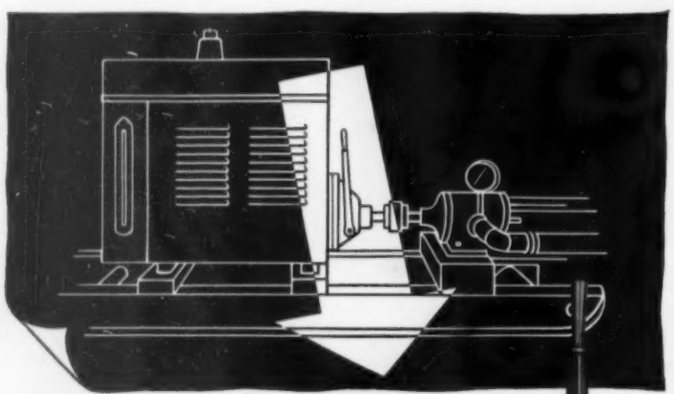
ENGINES, Inc., Chicago, industrial and marine engine dealer, and Ford diesel dealer, reports installation of a Ford 220 diesel in a Bantam C-35 shovel owned by C. & B. Construction Co., Chicago.

DUN-CO Equipment Co., Springfield, Ill., is a new dealer for Trojan tractor shovels, made by Yale & Towne, with Trojan models powered by Cummins diesels of 110 to 220 hp. They are also dealers for Ford diesels, diesel-equipped Joy air compressors, and authorized service station for American Bosch injectors.

CROUCH Bros., Inc., common carriers, which recently added a fleet of International tractors with Cummins diesels, has added 10 Brown aluminum refrigerated trailers, using Thermo-King equipment with Mercedes-Benz 4-cylinder diesels.

FORSYTH-CARTERVILLE Coal Co., Clayton, Mo., has taken delivery on an International TD-20 with dozer from Missouri-Illinois Tractor Co., at Hazelwood, Mo.

EMERGENCY equipment being installed at Midwest Relay Center Radio transmitter station, Ft. Leavenworth, by AAA Engine & Electric, Inc., Kansas City, Kan., consists of two 500 kw Waukesha Enginators, with Waukesha VLRDBSU exhaust turbo-charged V-12



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Available in a wide range of sizes for all popular makes of engines.

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Export Sales Borg-Warner International 36 So. Wabash, Chicago, Ill.

diesels. Engineers for job are Robert R. Bayless and Associates; contractors are S. R. Brunn Const. Co., Kansas City.

INTERNATIONAL TD-20 with Drott 4-in-1 loader to Millstone Construction Co., Inc., Brentwood, from Missouri-Illinois Tractor Co., Hazelwood, Mo.

NUMBER of Getman Model KD2 Scoot Crete ore carriers with Deutz diesel F2L-712 to mining companies in the Grand Junction, Colo., area and to several other operators on the Colorado Plateau.

BEKINS Van Lines, which operates nationally and through the Middle West, has added seven GMC diesel tractors to its fleet, equipped with V-6 2-cycle diesels and cabs with full air suspension.

INTERNATIONAL TD-15 with dozer to Floyd Kinder, Payson, Ill., from Missouri-Illinois Tractor Co.

SMITH Grain Co., Limestone, Tenn., has taken delivery on 75 GMC V-6 diesel tractors for grain hauling. Cabs are aluminum, tilt with air suspension.

OBSERVED: Springfield, Mo., new Kenworth COE with Cummins diesel, pulling Del-Tex Candy Co., trailer from Dallas.

ALLIS-CHALMERS new diesel generator sets with brushless generators are proving popular where the jobs are tough such as construction jobs and rock plants. Recently powered with an Allis-Chalmers 16000 diesel generating set was a large crushing plant near Great Falls, Montana, which provided current for conveyor belt motors. Primary power was diesel—Allis-Chalmers 21000 turbo-charged diesel.

BENNETT Construction Co., Kansas City, holders of a contract on the U.S. 50 expressway through Jefferson City, Mo., has added three Koehring 15-yd. Dumptors and a D8 Caterpillar to its extensive spread of equipment. Dumptors have 6-71 GM diesels.

BENNETT Smith, Inc., general contractor at Fredericktown, Mo., has taken delivery on an International TD-15 with dozer from Missouri-Illinois Tractor Co., Hazelwood, Mo.

NEW exclusive Caterpillar Power Dealer is Ingersoll Corp., headed by veteran diesel and gas engine expert, James H. Hoag, president, with Caterpillar Power Centers located in Little Rock, Ark., and Shreveport, La.

ROEPER Ford Industrial Products, Inc., 7501 Manchester, St. Louis, Mo., is offering 220 and 330-cu. in Ford diesels, with 12-volt quick start systems in the St. Louis industrial area. Both engines are available as engine assemblies or power units.

JOHN Deere Co., Industrial Div., St. Louis, report increase promotion and new dealers signed for its dieselized construction equipment, particularly the John Deere 840 diesel with 7½ yd. elevating scraper.

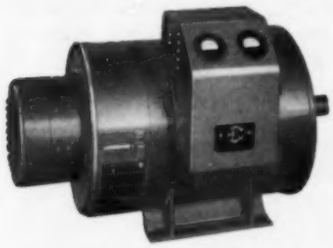
New Diesel Fuel

A fuel "tailor made" for diesel engines and said to improve performance and reduce maintenance problems has been introduced by Standard Oil Company (Indiana). The new Premier diesel fuel will be available as fast as it can be made by the company's refineries in the Midwest. The new fuel is said to cut wear of injectors, burn better, reduce costly repairs, and give maximum power and mileage with minimum engine deposits, smoke and odor. Standard's Premier diesel fuel will replace Stanolind and Stanolex diesel fuels. It will be colored red to distinguish it from distillate heating oil often used for diesel engines, and handled separately to ensure use only as a diesel fuel. (ITS NEW)

Power on tap!

A NEW 5 TO 50 KW "PACKAGED" GENERATOR

REG-AMP



REG-AMPS are available for 1800 and 1200 rpm operation, single- or 3-phase power, at all standard low voltages. REG-AMP shown has single bearing. Two bearing units are also offered.

It's a complete source of a-c electric power and the perfect mate for your engine

REG-AMP is a revolving field a-c generator with direct-connected exciter, built-in automatic voltage regulator, and a-c ammeter and voltmeter. It's factory assembled, internally connected, and tested.

Regulates voltage automatically. Simple relay constantly senses output voltage and keeps it right for best operation of your motors, lights, and electronic equipment.

Positive voltage control. Voltage can be adjusted to compensate for line voltage drop or normal engine speed droop under heavy load.

Starts big motors fast! Coordinated regulator design gives quick response.

Easy to install, simple to operate. Fully self-contained. Requires no switchboard. Merely couple to engine and connect to load thru suitable switch.

Needs little maintenance. Only an occasional check for cleanliness and brush wear.

Fabricated steel frame. Rigid, dripproof frame keeps REG-AMP safe, clean, and dry.

Performs smoothly. Every design is painstakingly engineered. REG-AMP is a product of 50 years of E-M Generator experience.

Get more information from your nearby E-M Sales Engineer. Also, write E-M for publication PRD-246 . . . it gives complete REG-AMP ratings.

E-M

2180-TPA-2182

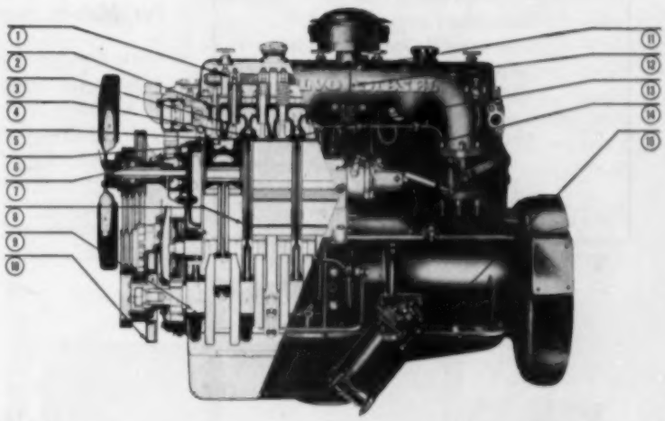
ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota

Largest manufacturer of "Packaged" Generators

Power Pace-setters for over 50 years . . .

VOLVO DIESELS

are rugged, economical, outstanding performers



Put this power *that pays for itself* to work for you! Superbly designed and built in Sweden, VOLVO Diesels feature direct injection, open combustion chamber, 4-cycle operation. They purr into action at the press of the starter, cost very little to run and maintain, have a world-wide reputation for durability and quiet, smoke-free service. 9 models, 1 to 6 cylinders, 5 to 185 h.p. for industrial, stationary and marine service. Cutaway shows typical Volvo construction features.

Toroidal "noiseless combustion" chamber (6) perfectly blends fuel and air to provide maximum power output and fuel economy, eliminating carbon deposits and wasteful exhaust fumes.

Wet cylinder liners (8) with rubber "o" rings mounted in engine block stop corrosion and wear, preventing cylinder misconfiguration. Pistons are quick and easy to replace. Eliminates costly reboring.

Wear-resistant valves (3) are built for extra long life. Stellited faces (4). Hard-chromed stems (2). Specially hardened alloy caps (1).

Long-life light alloy pistons (5) with hard-chromed upper piston rings resting in inserts (7) of special cast iron to withstand heat and pressure.

Other outstanding Volvo engine features: Large bearing areas (9). Viscosity type torsional damper (10). Steel-laminated head gaskets (13). Dual cylinder heads (11). Time-tested multiple unit injection pump (14) for accurate precision fuel metering. Full-flow lub. oil filter (15). Split-type manifold (12) to avoid heat stress breakage.

Write for complete data on entire Volvo diesel engine line and Volvo service.

Volvo Import Inc.

452 Hudson Terrace, Englewood Cliffs, N. J.

VOLVO

D.P.S.
THERMOMETERS

These instruments are a series of marine type thermometers designed for all diesels and all plant uses—water or oil.

FEATURES All brass construction, nickel finish, cork insulation.

(Repair service available)

No. 416H Price $6.75 ea
No. 436F Price $5.70 ea

40 years continuously in the diesel engine business.

Write for catalog.

DIESEL PLANT SPECIALTIES CO.
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FOR SALE! NEW DIESEL CYLINDER HEADS

Baldwin-Lima-Hamilton Model VO
Buda Model 1125
Caterpillar Part No. 6H4177
Cooper-Bessemer Model ENN-6S
Cooper-Bessemer Model GSB
Cummins Model L
EMD Model 567, Part No. 8034999
LeRoi Model 471

ENGINE PARTS CO.
P. O. Box 82, Long Island City 1, N. Y.

Lister-Blackstone Promotions

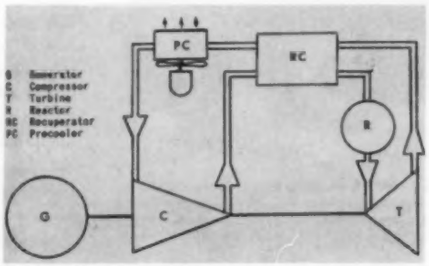
B. D. Fish

P. G. Clarke

During his recent visit to the United States, Sir Percy Lister, chairman of the Lister group of companies, announced the following promotions in Lister-Blackstone, Inc.: Mr. B. D. Fish to the position of director and general manager, and Mr. P. G. Clarke to sales manager. Lister-Blackstone, Inc. was incorporated in Wisconsin in 1938 and Fish has been with the organization since 1942. Mr. Clarke has been with the parent company in England since 1946 and on the sales staff of the American organization since 1957.

Turbine-Compressor Set For Mobile Nuclear Power Plant

Clark Bros. Co. has been awarded a contract to design a closed cycle nitrogen turbine-compressor set for use in the first nuclear power plant of this type. Designed to generate approximately 400 kw, this prototype power plant is being developed to meet several important military requirements. It will be extremely compact, light enough for air transportation, and capable of dependable performance under severe conditions ranging from the Equator to the Arctic Circle. Aerojet-General Corp. is the general contractor for the Army gas-cooled reactor program which is a joint project of the Atomic Energy Commission and the U. S. Army Corps of Engineers. The concept of a mobile nuclear power plant involves the use of nitrogen gas in a pressurized closed cycle system. The nitrogen is introduced to the compressor at approximately 8 atmospheres, compressed to 20 atmospheres, passed through a recuperator where it picks up heat from the turbine exhaust and finally through the nuclear reactor which raises the temperature to 1200 degrees F. As the hot nitrogen expands in the turbine, it provides energy to drive the compressor, as well as the generator. After expansion, the gas is cooled back to 150 degrees F., in the other side of the recuperator and in a special precooler, then fed to the compressor for recycling. The Clark turbine is a single-shaft, axial flow type built to operate at 22,000 rpm. It is similar to conventional axial flow units but is designed to weigh less than a ton. Light metals will be used for static parts not subjected to severe temperatures. The Clark compressor which is driven by the turbine, is also a high efficiency, axial flow type. Although designed for pressurized nitrogen, the turbine-compressor set can operate with air under emergency conditions. The entire power plant will be transportable in four packages totaling less than 38 tons. Either standard Air Force cargo aircraft or standard Army low-bed trailers could be used to transport the package. The reactor plant could be put in operation 12 hours after delivery at site. A major step toward the development of the prototype power plant was made on February 23, 1960 when the Gas-Cooled Reactor Experiment No. 1 achieved criticality at the National Reactor Testing Station of the Atomic Energy Commission near Idaho Falls, Idaho.



Clark Bros. Co., will furnish a closed cycle nitrogen turbine-compressor set for this proposed nuclear power plant. Nitrogen is compressed in the axial compressor at left, passed through a recuperator where it picks up heat from the turbine exhaust and fed through a nuclear reactor which raises the temperature to 1200°F. As the hot nitrogen expands in the turbine, it provides energy to drive both the compressor and generator. After expansion, the gas is cooled in the other side of the recuperator and in a precooler, then fed to the compressor for recycling.

New F-26 Voltage Regulator provides ±1% regulation . . . is completely static

The new Fincor F-26 Voltage Regulator is a completely static, magnetic amplifier controlled device which provides regulation of ± 1%. (Much closer regulation is obtained with most generators.) The compact, lightweight, Fincor F-26 has no tubes to fail . . . requires no warm-up time . . . is ruggedly constructed for long, trouble-free service under conditions of high shock and vibration. It is designed for use on 50-60 cycle generators or exciters requiring a dc field supply up to 1.8 amps at 125 volts or less. A field forcing relay for motor starting is available at a slight extra cost. For complete information, write for Bulletins 3200 and 3210.

NET COST $149.00

Other Fincor Voltage Regulators are available for use with generators needing up to 5 kw field power

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F-26/60

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Diesels Move Perishables Quickly

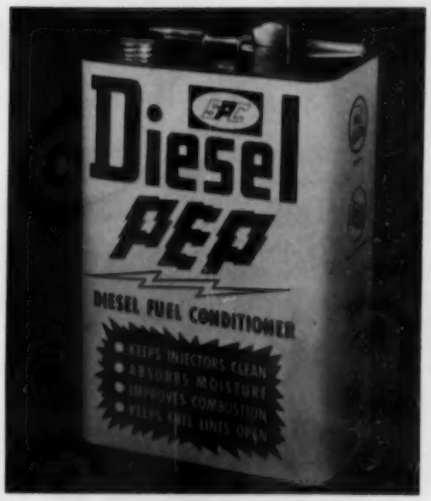
Supplying more than 1500 widely scattered retail grocery stores with a multitude of items is no easy task. The problems presented are many and complex, including transportation. But Orange Empire Co-op does the job and does it efficiently, using a large fleet of Diamond T trucks. Of the fleet of nearly one hundred, more than fifty are 921N's—heavy-duty diesels which pull refrigerated tandem-axle trailers loaded to the legal limit with perishables. The balance are gasoline jobs used for short hauls and city delivery. The big orange diesels are dispatched with clock-like precision from company headquarters at Riverside, Calif., and from warehouses spotted in four other communities. The 921N's run blanket most of a 4-state area, including California, Arizona, New Mexico and Nevada. Fleet-wide, the 921N's average 5½ mpg of fuel, despite the rigorous runs which include stop-start city traffic, long and seemingly endless grades over the passes and the scorching-hot desert. Although the 921N's are light in weight, they are of heavy-duty construction throughout, and include the following components: Cummins NH-220 diesel engine; Timken FE900 front axle and U200 rear axle; Spicer 8255 main transmission, 8035G auxiliary transmission and 14 in. 2-plate clutch; Kysor automatic radiator shutters and Bendix-Westinghouse air brakes. Gross combination weight rating of the 921N is 65,000 lbs.; tire size of Orange Empire's diesels is 10.00 x 22.

SAVE MONEY WITH Interstate

diesel service incorporated
2093 East 19th St., Cleveland 15, Ohio
America's largest GM fuel injector rebuilder

New Fuel Conditioner

A new product recently introduced by Spray Products Corp., Diesel Pep is a combination of solvents, dispersants, special oils and other ingredients specifically formulated to improve the performance of all type diesel engines. If used according to directions, the maker claims Diesel Pep will keep injectors, screens, filters and fuel pumps clean, improve combustion, disperse water, keep fuel lines open, prevent rust and acid formations,



remove gum and varnish, reduce engine wear, and eliminate wax, sludge and other harmful deposits and minimize smoking. Diesel Pep is used by adding the required quantity to the fuel tank at any temperature and then operating the engine in the regular way. This is recommended by the maker for regular maintenance. Where the engine is extremely sluggish and power loss is evident, double the usual quantity is recommended for the initial treatment. Diesel Pep will be sold along with Spray Starting Fluid, Spray Nuts Off and other Spray products by established dealers throughout the U.S., Canada and foreign countries.

ITS NEW

BRIGGS OFFERS YOU, FREE, A COMPLETE FILE SIZE DIESEL CATALOG COVERING ALMOST EVERY TYPE INSTALLATION IN THE DIESEL FIELD

A BIG HELP in writing specifications, a handy reference in planning and maintaining any type installation where diesels are used . . . in fact, a good source of diesel information that you can use day in and day out. Send for your copy today; no obligation.

Briggs
FUEL AND LUBE OIL FILTERS
FILTER/SEPARATORS

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YES! At no cost or obligation, send me your Above Manual.
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Company .....
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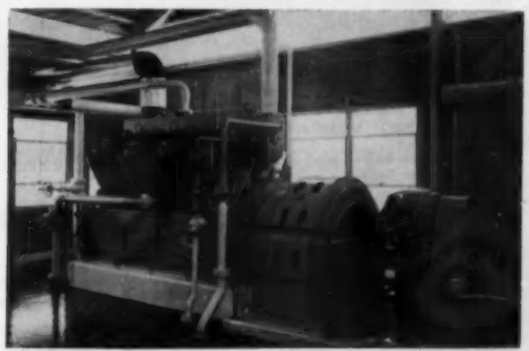

INGERSOLL-RAND GAS ENGINES AND KITTELL SILENCERS
..An efficient power team!

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